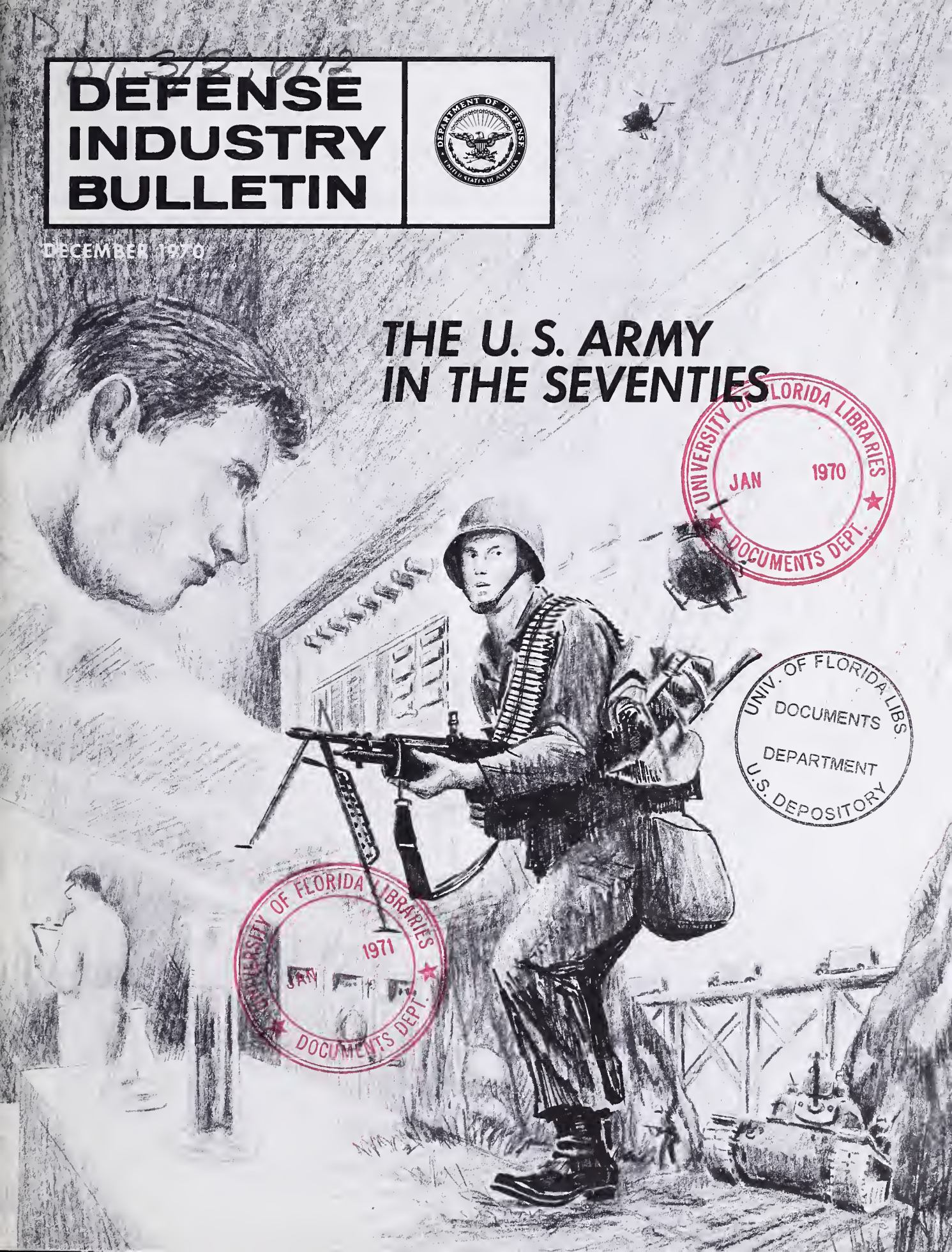
DEFENSE INDUSTRY BULLETIN

DECEMBER 1970

THE U. S. ARMY IN THE SEVENTIES



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Suggestions from industry representatives concerning possible topics for future issues are welcome and should be forwarded to the Editor at the address shown below.

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The Future Army—A Volunteer Force

Excerpts from address by Gen. W. C. Westmoreland, USA, Chief of Staff, U.S. Army, at Annual Meeting of the Assn. of the U. S. Army, Washington, D. C., Oct. 13, 1970.

I am announcing today that the Army is committed to an all-out effort in working toward a zero draft—a volunteer force. In accepting this challenge, we in the Army will bend every effort to achieve our goal. But we need support and understanding from the Administration, the Congress, and our citizenry.

As you know, the Army is in a period of sweeping transition. We are redeploying forces from Vietnam, inactivating units, and reducing the size of our support base in the United States in order to come within reduced budgets. And we are still fighting a war. We currently have 300,000 Army troops in Vietnam. By next summer, after the withdrawal of those troops announced by the President, about 200,000 soldiers will remain. This is a large force executing an important and difficult mission. These forces must be supported for as long as the President chooses to keep them in action.

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If this nation supports the President's chosen course in ending the Vietnam War, I believe the draft must be extended beyond its expiration date of June 30, 1971. Additionally, we must appreciate that movement toward a volunteer force will take time and continuation of selective service will guarantee a transition period without jeopardizing this nation's defenses. And finally, and most important, even though we reach a zero draft, selective service legislation should remain in force as national insurance.

I am well aware of arguments both for and against selective service. Furthermore, I recognize that the Administration has committed itself to reducing the draft to zero. But I am also aware of the problems that confront the Army as we move toward a zero draft.

The Army's strength is a function of the combined capabilities of both its active and Reserve components—the "one Army" concept. Therefore, as our active forces decrease in size, the Reserve components take on increased importance. Both are vital to this nation's military capability, and both will be affected as we move toward a zero draft. A significant part of this country's military potential and one frequently ignored is the Individual Ready Reserve—a manpower pool of almost one million trained reservists who could be used in national emergency to fill Reserve as well as active units. This necessary adjunct of the Army Reserve is sustained by current selective service legislation.

We know that many in Army Reserve components are motivated to enlist as an alternative to being inducted. In view of this, a large part of our problem is to increase the number of volunteers in the Army Reserve and National Guard at the same time we increase volunteers in the active Army.

How we manage the transition from an Army of over a million and a half men to one very substantially smaller is crucial in our movement toward attracting more men.

- If we decrease our active forces in such a way that we are required to force out of the Army a significant number of volunteer officers and men who have already established their professional commitment and ability—some with two or more years of active combat—we will hardly be

Gen. W. C. Westmoreland, USA

in a good position to attract new men into our ranks.

• Conversely, if we confront our young sergeants and junior officers with no chance for promotion for many years, we face the prospect of losing many of our most capable young leaders. At the same time, we present a dismal picture of career attractiveness for those we wish to recruit. If we are to attract and, more importantly, retain young talent, reasonable opportunities for advancement must exist.

We cannot have the Army our nation needs without good people. We need quality as well as quantity and in the appropriate skills to meet our needs. This is our primary task. We accept it as a matter of the highest priority and utmost importance.

Success can only be achieved by a concerted effort in four areas simultaneously:

• First, those of us in uniform in positions of high responsibility in the Army must attack this problem with all of the vigor, imagination, and dedication we can muster, and we must apply ourselves intensively to the task.

• Second, we must eliminate unnecessary irritants and unattractive features of Army life where they exist. But we will hold to those immutable principles of dedicated professionalism, loyalty, integrity of character and sacrifice. They are the hallmarks of a disciplined, responsible Army. All else is secondary. Young Americans thrive on challenges and high standards. We must ensure that all activities have a perceivable need. Understandably, exercises without a justifiable purpose "turn them off."

• Third, we will not achieve our goal without the application of resources, and I mean money. We will need to increase pay. And we will probably find that we must put our money primarily in those jobs which are most arduous and have the least application to civilian pursuits—the infantry, artillery, and armor. We will need money for housing our people—an item for which we have deferred needed expenditures throughout the Vietnam War. We will need money to maintain those houses. We will need modern barracks. We will need money for civilian labor contracts so that our helicopter mechanics are not cutting grass and our radar technicians are not washing dishes.

• Fourth, we will need the support of the American people and their leaders in business, industry, the church, education, and the news media. We cannot attract the kind of soldier we need into an organization denigrated by some, directly attacked by others, and halfheartedly supported by many. This country cannot have it both ways. If the Army is portrayed and believed as a military service to be avoided at all costs, a Service in which only those with the least qualifications need be recruited, and if we do not have the active help of community and national leaders in every field, even money will not do the job.

Success is required in these four areas if we are to achieve our goal. But the Army has sufficient control to produce what is required only in the first two. We can attack the problem immediately and energetically. And we can work toward making life in the Army more attractive for those young men we want to volunteer. But in the other two areas, we need help from the Administration, the Congress, and the citizenry of our nation.

I hereby commit the Army to the achievement of the first two objectives.

* * * * *

I am appointing a senior general officer as project manager, reporting directly to me and to Secretary [of the Army] Resor. His mission is to raise to the maximum extent possible the number of enlistments and reenlistments in both the active Army and Reserve components. This officer will have authority similar to that of the project managers of major weapon systems currently in the Office of the Chief of Staff.

Second, we are immediately increasing the size and quality of our recruiting effort.

And third, at all levels throughout the Army, senior officers will be charged personally with the responsibility for increasing the retention of good people, both by improving the living standards of their men and families and by an intensive effort to capitalize on the many attractive features of Army service.

Our Army is an organization of young people. Today the average age of those in the Army is less than 23 years. Over three-fourths of our enlisted strength has less than three years of service. The young men who are and will become our soldiers and junior officers have attitudes that differ from those of our older group of officers and noncommissioned officers. To ignore the social mores of this younger group is to blind ourselves to reality. Their values and attitudes need not necessarily be endorsed by Army leadership, yet we must recognize that they do exist. We must make military service life better understood by those who fill our ranks.

We will leave no stone unturned. We are willing to part from past practices where such practices no longer serve a productive and useful end. We are reviewing all our policies and administrative procedures. Nothing is considered sacrosanct except where military order and discipline —the soul of the Army that ensures success on the battlefield—are jeopardized. In this, we cannot and will not yield. We will continue to hold to the principles that have traditionally guaranteed this nation a loyal Army.

Those of you who have worn the uniform of our country look back on your service with satisfaction and pride. After the dust has settled, I am sure such will be the case with our younger generation. The important thing is that the Army not only provides an opportunity for the young people of our country to serve proudly but also provides them an opportunity to prepare themselves to be better and more effective citizens.

Today, the Army of the United States has committed itself to moving toward a volunteer force with imagination and full energy. But our success will require the assistance and support of the Administration, the Congress, and the public.

Our efforts, alone, will not be enough. All citizens must do their part. We will need assistance from many quarters. We invite your help.

Budget Constraints Require Greater Selectivity

Address by Hon. Robert L. Johnson Asst. Secretary of the Army (Research and Development) at Sustaining Members Luncheon, Annual Meeting of the Assn. of the U. S. Army, Washington, D. C., Oct. 14, 1970.

I know you are all well aware of the environment we work in—declining troop strengths, fewer dollars and, not necessarily on the same order of magnitude, public and Congressional pressure to do with less. These hard facts of everyday life place a tremendous responsibility on our shoulders. Notice I say *our* military and industry shoulders; for in such an environment, military requirements and industrial costs must be realistic, rock-bottom necessities adequate to appropriately provide for our national defense. As [Secretary of the Army] Resor stated:

> "We know that we cannot let the quality of our force decline with its number. We must develop the weapon systems which we will need by the end of the decade. We also must balance our needs for development against our procurement requirements so that we do not slight either of the vital interests involved."

It is clear that we cannot attempt to carry through development and deployment of nearly all the attractive schemes for new systems. Just because a very difficult, expensive, challenging project seems possible, and some people want to do it, is not in itself a sufficient reason for its undertaking. There must be a better reason for allocation of scarce resources.

One of the things we can do is to be selective as we attempt to focus short program dollars. We should only start development programs that we can finish. Those which we start ought to very clearly have the highest priority so that, in fact, they are well established and we can maintain their funding. Slipping of funding, dropping of funding, slowing of funding are major causes of cost growth and wasted money. So, clearly, a better job of selectivity for the real requirements is something we can do.

Industry can structure its independent research and development program to provide support of the pivotal technologies that we will need in the future. Industry must be as selective as the Services in deciding which programs or projects will be fully funded because benefits accrue to both parties.

A thorough tradeoff analysis should be made before development of a new major weapon system is started. After examination and analysis of all pertinent factors, an acceptable solution may be improvement of existing systems or an increased deployment of the fielded system.

Very few weapon systems are so essential that they must be developed regardless of cost. The atomic bomb was such a weapon. The ballistic missile and the Polaris submarine may be in the same category; however, weapon systems of this importance do not come along very often.

One of the very best ways to reduce costs is to scrub our requirements to ensure that new capabilities are limited to essentials. This has the added advantage of reducing the complexity of new weapon systems.

We must remove every non-essential item that does not contribute to combat effectiveness. In some cases, we may even have to accept a degradation of effectiveness we think would be nice to have in order to achieve a significant increase in current capabilities.

We must resist major changes in requirements once the engineering development program has started. Tradeoffs to solve problems arising during development must be made, but major changes to meet major changes

Robert L. Johnson is Assistant Secretary of the Army (Research and Development). Prior to his appointment to this position, he was Vice President for the MOL Program and Assistant General Manager of the McDonnell Douglas Astronautics Co., Western Division. He held key engineering and administrative positions in the Douglas Aircraft Co.'s missile and rocket programs from 1946 until the merger with McDonnell Aircraft Co. in 1967. Mr. Johnson holds B.S. and M.S. degrees in mechanical engineering from the University of California at Berkeley.

in requirements cannot be done without loss of time and considerable increases in cost. If we have done our homework properly before the project is initiated, major changes in requirements will not be necessary.

In addition to the many performance requirements which must guide system and detail design, I would like to propose several more that flow directly from reduced strengths and lower budget. This will mean fewer men to man our systems and conscious action must be taken to reduce the number of men required to operate and maintain them in the field. This is also one aspect of reducing life-cycle costs which is another area requiring attention. Then there is the problem of the magnitude of initial acquisition costs. Between systems which have equal life-cycle costs, that system with the lower initial acquisition cost will almost always be preferred because of the pressures of near-term budgets.

The ever present problems of reliability and quality assurance are those which industry is uniquely qualified to address. Techniques of system and detail design for reliability, proper component and subsystem environmental testing, and the array of quality control activities are specialties which must be properly applied. Equipment which operates properly over the expected span is the hall-mark of a company of high integrity.

We should adopt contracting procedures consistent with development unknowns. We must recognize the uncertainties inherent in any significant development program involving substantial departures from prior designs. Our methods of contracting must allow the flexibility required on the part of both industry and Government, implying a considerable dependence on cost plus incentive type contracts.

In the past we, perhaps, relied too much on paper studies in lieu of testing hardware. You probably remember the catch phrase: "Paper costs less than metal." I would be the first to admit paper studies have their place, but some full scale engineering tests are necessary to resolve certain high technical risk elements of a program. Such testing is included in the concept presently identified by the phrase: "Fly before you buy."

We must have adequate testing before production. A test program that produces the data we need for decisions can be developed without becoming an unnecessarily long time-consuming program.

I know that some in both the military and in industry view the forthcoming decade with great anticipation and, in some cases, horror, at the thought of austere budgets and forces. I, however, view it quite differently. I see the period as a most challenging and exciting era in which we are all called upon to put forth our greatest talents in meeting the Army's contribution to the defense of the nation. I look forward confident of success.

Modernization: The Army of the 1970s

Presentation by Lt. Gen. George I. Forsythe, USA, Commanding General, Army Combat Developments Command, at Annual Meeting of the Assn. of the U. S. Army Washington, D. C., Oct. 13, 1970

This is undoubtedly a critical decade, a particularly significant turning point for the Army. This is so for many complex and interrelated reasons familiar to all of us. Suffice it to say that a combination of domestic, international, social and technological factors—all characterized by a dynamism unique to our rapidly changing world—make it imperative that institutions, public and private alike, take some good hard looks inward and outward.

The Army has taken such a look and come up with four specific goals which we call the four Ms—mission, motivation, management and modernization. . . . Modernization . . . is the real title for my presentation. We can scarcely talk about the Army of the 1970s without addressing the goal of modernization.

Progress, of course, is not a free commodity. It extracts its price. For the Army, progress is a continuing improvement in our capability to ensure the nation's security and defense. This is a worthy objective, to be sure, but one, nevertheless, that must be garnered at the least possible cost. This is no more than sound economics.

Like any other organization, the Army has a big say in determining how it will make its payments for progress toward optimum modernization. We have choices to make and

Lt. Gen. George I. Forsythe, USA

decisions to reach, all of which reflect a wide range of options from which progress can be derived. But all these choices and all these decisions must fall within the limits of our available and projected assets. That is a crucial point: We must get the most for our money and the most from our people.

This will be the big test of our adaptability in a dynamic world. This is the time to decide the steps we should take to maximize the premiums of a severely constrained investment base. Pursuing that particular line of thought, it is revealing to contrast our country's national defense investment base with that of our potential enemies. This can shed a lot of light on where we stand right now.

To make this comparison, or contrast, I suggest applying a concept of "cost tolerance," to which, incidentally, I was recently introduced by a young ROTC student. The concept or principle of cost tolerance is an especially illuminating frame of reference now when the Army is trying so hard to balance increased capability requirements against the reality of dwindling resources.

Cost tolerance can be defined as:

The measure of a nation's willingness to subsidize expenditures, both in terms of manpower and material assets, for purposes of national defense.

Our enemies have displayed a very high cost tolerance in committing resources to support the attainment of national or political objectives through the medium of military might. This tolerance shows, furthermore, little likelihood of diminishing. If anything, the opposite can be claimed if we will briefly examine Soviet and Warsaw Pact force structuring and strategy in Europe.

These forces are organized on the basis of the principle that shock action on the battlefield to maintain or turn the tide of combat is to be obtained through *mass*—massive and overwhelming applications of force. Forces are, therefore, oriented to massive armor and mechanized capabilities, massive artillery support, deployment of mass forces on narrow fronts, massive tactical air capabilities, and tactics of deep penetration with swift thrusts and multiple echelons to maintain pressure. All this reflects a high Communist bloc cost tolerance for the material and human resources that must be invested in order to equip and organize forces that are designed from a shock-through-mass strategy. The threat this poses is further enhanced in that the enemy shock force features a technological sophistication comparable to that of Free World forces.

Halfway around the globe in Southeast Asia we can again discern, in the example of North Vietnamese and Viet Cong tactics, that a high cost tolerance lies at the very heart of the unique shock capabilities of aggressing forces in the counterinsurgency, or low-intensity warfare, environment. While the level of technological sophistication may be inferior, more than sufficient compensation for this, appropriate to the form of combat being undertaken, is achieved to a great extent through a willingness on the part of this bizarre enemy to commit human resources extravagantly to attain military-political objectives. In fact, this extravagance with human life is a source of continual and real horror to our people because Americans, as a people, are accustomed to placing a high premium on human life. Unlike the Communist guerrilla, we are repulsed by "human wave" tactics employed with frequently only a slim chance for gain on the battlefield.

Turning our eyes inward now, we detect a multitude of complex trends in our society generating pressures against the draft, against a large army, and against the allocation of large sums of money from the national budget for hardware and systems development and acquisition. Clearly America's cost tolerance is at a lower level than that of our enemies, and for the foreseeable future would appear to be on an overall downward incline. Also, this trend will necessitate reductions in manpower strengths for our armed services.

So with increasingly fewer men we must provide a capability to effectively counter a threat that our intelligence tells us shows no promise of diminution. This is the very hub of the challenge to the Army of the 1970s: to accomplish that task. It isn't impossible, but it will call for great innovation, introspection and willingness to make adaptations. How can it be done?

It must be done by tremendously increasing each man's effectiveness by aiding him with machines and technology. This increase in effectiveness will simultaneously provide a corresponding increase in each man's survivability on the battlefield. But because material acquisition is also keyed to cost tolerance, we must ensure that the machines and technology not only are effective, but are used so as to stretch their utility to the maximum. This is the heart and soul of the modernization goal.

Thus, our forces must be structured to accomplish a maximization of materiel assets. This is a matter of getting ahead in the power curve with the designs of organizations and doctrinal concepts and techniques geared to derive the greatest possible benefit from each and every component of the force—whether that component is as elemental as the basic man/machine relationship of the soldier and the weapon and gear he carries into battle, or as complex as a systematic scheme for battle area surveillance or support structures.

What I've said to this point can be summarized in a basic assumption:

America's cost tolerance, in terms of manpower and materiel alike, will not support forces designed on the principle of *mass* as the means to match our mass-oriented enemies in achieving shock action in combat. Shock-through-mass is not and cannot be the U. S. strategy.

But we must prepare for military operations in this age of the shock army. We should do this by seeking and then adding shape and substance to an alternative that will defeat shock-through-mass.

Such an alternative is within our grasp today. Furthermore, it is to a good degree already reflected in the record of the past decade, characterized by astounding advances in firepower lethality and in the ground and air mobility of our combat forces in Vietnam. How successful we are in

moving forward toward this alternative will depend on our ingenuity in transplating the experiences of the 1960s and applying them innovatively to satisfy the tasks the Army faces in the years ahead.

I use the term "translate" deliberately, because it would be wrong to think that these experiences can be simply *transferred* wholesale. Unfortunately, it isn't that easy; but the seeds exist for creating a powerful alternative to shock-through-mass.

What is that alternative, and what relationship do the Army's current experiences and efforts bear to it?

Alternative to Mass

I contend that shock action on the battlefield can be created not only through mass and overwhelming power, but also through *agility* and *effectiveness.* Proper force structuring applying these two principles can result in shock to the enemy. Having used the term "shock" repeatedly today, I think this is the time to roll out a definition.

Shock can be defined as a loss of the opponent's physical ability to continue fighting. It can also be the loss of his *will* to continue fighting, a psychological consideration. It is loss of his freedom of action in selecting alternative and less costly courses of action that might permit him to continue fighting. Finally, it may be the loss of his hope for an acceptable outcome to the battle, another way of saying that he sees disaster as a certainty. Normally, of course, it is an interplay of several of all of these effects that ultimately undermines the fabric of the enemy's combat capability and causes it to disintegrate.

History records numerous instances where tactics of shock through *agility* and *effectiveness* have outstripped shock-through-mass. Stonewall Jackson was a master of agile and timely countermarches that defeated far larger enemy forces. Sherman, in his southward campaign from Chattanooga, delicately gauging factors of timing and effectiveness, chose to run away from his less agile and mobile support forces to beat starvation to Savannah where the fleet could replenish his units. Perhaps Napoleon, after his dashing campaign in Italy that brought the defeat of a massive Austrian force in 1797, best expressed the principle of an alternative to shock-through-mass when he chose, in his words, "to concentrate a temporary superiority of force *at the point of balance.*"

By taking a somewhat more detailed look at agility and effectiveness, let us envision how today's Army can direct itself toward the design of shock forces that will be equipped, organized and trained to concentrate temporary superiority at the point of balance in engagements with more massive and overwhelming forces.

Agility is the quality of a combat force that lets it reduce its own vulnerability, concentrate or disperse its resources rapidly to retain a winning edge in the ever changing battlefield scenario, all the while denying to the enemy targets to overwhelm with his mass.

The key to agility is far more than mobility alone. The ability to move becomes agility only when the maneuvering force moves always to the right place at the right time and deals a blow that is precisely appropriate and sufficient for the situation, and when the ease and speed with which it accomplishes this surpasses the opponent's capabilities to react effectively.

Effectiveness encompasses those features of the agile force that actually enable it to strike the precision blow. Every shot should be, ideally, a sure-kill, striking the enemy where it hurts him the most, *i.e.*, at the point of balance. This pinpoint accuracy, in addition to relying on the performing efficiency of the system and all its material and human resources, must also rely on our ability to leave no enemy move undetected or unopposed, unless there is a deliberate choice made by the commander not to oppose at that particular juncture in the battle. So this is another "must" of effectiveness. Finally, effectiveness implies the ability to engage key components of the enemy's power apparatus and to defeat these quickly and completely. These key components—the points of decision making and command—may frequently be the point of balance, the destruction of which would cause a disintegration of the enemy's will, his ability, and his hope for victory.

Inherent in the principle of effectiveness—as in the principle of ability — is *timeliness* which is knowing in real time what both enemy and friendly forces are doing so that the commander will be able to achieve decisive results by employing agile forces with total effectiveness at the right time and the right place.

Nature of Battle

How do these alternative shock principles—these two alternatives to sheer mass—relate to the great potential on tap in the Army today? I want to bring that into focus now, and to do it I would like to take a look at the nature of battle itself and then play off some of our recent experiences and current efforts against this analysis to show how they might apply in a shock force such as I've just described.

There are some essential phases or activities involved in battle. The capabilities of a force are a direct reflection of how well these activities are accomplished.

A long time ago the platoon sergeant of my first rifle platoon taught me a marvelously simple and effective version of a combination of a conventional estimate of the situation and a field order. This was: *job, enemy, own troops, ground, ways, best way.*

If one examines the first four of these—job, enemy, own troops, and ground—one can quickly come to the realization that any combatant must have a thorough comprehension of these four *before* the battle is joined. Moreover, in the context of modern land combat, even though a vast amount of preparation must take place, this comprehension must occur with unprecedented speed.

We must obtain information about the intentions, strengths, weaknesses and missions of the opponent and then convert this into hard intelligence infinitely more rapidly than ever has been required in the past. One of the great possibilities to achieve an increased effectiveness in this activity of comprehension lies now in the surveillance, target acquisition and night observation (STANO) program. Despite the complexity of STANO—and complex it

assuredly is—it addresses one very fundamental question, *i.e.*, where are the enemy forces right now? If we can know that, in real time, then we can derive far greater capabilities from our own units.

We must be able to completely comprehend the status of our *own* troops. The winner in battle will be the combatant who can create the proper force apparatus. This shouldn't be confused with creating a force structure; rather, it is organizing from one's assets a task structure appropriate for the situation as assessed by the commander from the intelligence at his disposal. Within the contention phase of combat, we must apply this task structure at the right time and place—the point of balance—to produce shock. Here our fires must be precise and effective; maneuver, keyed to timely information about vulnerable enemy targets, must be precise and decisive. The combination of precision fire and precision agility equals shock.

Integrated Battlefield Control

The concept of a battlefield where every unit can be deployed in the right strength at the right time and in the right place is Utopian. No one ever will get to that. But we can and must approach that concept. Our units' high-speed capability in movement to and into battle long since has outstripped Von Steuben's command and staff system. The result has been described as an "intelligence and control gap." Measures must be taken to ensure that our combat decision makers are kept up to speed.

The automatic data processing techniques associated with STANO and with other approaches to this problem, such as Tactical Operations System (TOS), the Tactical Fire Direction System (TACFIRE) and the Combat Service Support System (CS_3), provides vast potential for a follow-on concept we call the integrated battlefield control system—or eye-bix.

The standard and doctrinally sound *way* of "having two up and one back" may be in for substantial revision when we have real-time comprehension about our job, the enemy, the ground—and by this I mean the total environment—and our own troops. It may be that we will be provided many *ways*—many new and exciting options never before available.

And, of course, this same rapid access to hard intelligence will mean that truly the *best way* will be chosen as the course of action to be pursued decisively.

Implicit in my preceding remarks is the fact that the Army has a mobility potential that will require a stepped up command and staff system.

Basic Combat Forces

Throughout history there have been measurable phases of mobility and readily identifiable classification of combat forces. The basic types of combat forces have been, and still are, infantry, light cavalry, heavy cavalry and fire support.

The mobility of these forces evolved in three phases. At first, mobility was made possible by walking or running legs—infantry walked on its own legs; cavalry moved on horses' legs; and fire support forces moved by leg power. When the wheel was used, it still relied on the leg as the prime supplier of motive power.

Then the wheel was combined with the modern internal combustion engine and the walking infantry became motorized infantry. The light cavalry went to the powered wheel, and the result was the famous jeep of World War II; and the light, agile, mechanized reconnaissance vehicles of the 1940s and 1950s.

What about the tank? The tank is nothing but heavy cavalry on the powered wheel except, of course, that it happens to lay its own road and pick it up as it goes along. Fire support artillery, both self-propelled and towed, have similarly adapted the powered wheel.

This "progression" really brings the point home to roost, I think. In the few years past, we have seen the rotating airfoil become a new means of giving these types of forces a great mobility advantage. We have airmobile infantry—which is infantry retaining many of its traditional roles and missions—obtaining its mobility from the rotating airfoil. Light cavalry, which is represented by our air cavalry squadrons, is the logical marriage of the rotating airfoil to the classic cavalry organization.

Artillery has taken to the air, both with its aerial rocket artillery and

HEAVY CAVALRY ON THE POWERED WHEEL. Fifty-three tons of steel take to the air as a test model of the XM803 goes over a bump at 44.3 miles an hour at Aberdeen Proving Ground, Md. The tank's unique suspension system makes possible high speeds over rough terrain, and contributes to its tactical capabilities.

with the use of the medium and heavy lift helicopters as the prime mover of conventional tubes.

So *now* the question is: What about the rotating airfoil and heavy cavalry? Obviously, the tank is here to stay. Moreover, the tank in the 1970s is going to be very much like the tank we have known in the past. We hope that the U.S. army tank is going to be the XM803 [formerly called MBT70], which is a marvelous machine. Agile and effective, this tank, pound for pound, bids fair to be the meanest ground fighting vehicle in the world.

But there is another weapon system on the horizon that, in my opinion, belongs in the heavy cavalry classification. This is the attack helicopter, which, in its prototype form, is known as the Cheyenne. The mobility of the attack helicopter, as a companion to ground armored assault forces, holds extraordinary promise as a means to achieve an alternative to shock-through-mass. The unmatched capability of the attack helicopter to pop up, fire, and then drop out of sight makes it an exciting prospect as an agile and effective descendent of the tank destroyers of earlier days. This will be particularly true when it is properly supported by hard intelligence to ensure that it is employed with *timeliness.*

Forces consisting of appropriate mixes of combined air and ground capabilities offer a unique potential in providing the Army with sufficient shock power within the limits of cost tolerance. This combination may well emerge as the latest chapter now being written in the history of heavy attack cavalry.

Success in battle is achieved when the victorious force has *compelled* the opponent to behave as the victor desires, or instead face the alternative of paying a prohibitive price in casualties, time, or loss of purpose. To compel a force with the vast potential of mass to behave as we wish will not only require the lightning strokes at the point of balance at the outset, but also will require that we maintain continuous pressure throughout the full course of the operation. This continuous pressure on the enemy—to confound his capabilities and blunt his initiatives—will take great staying power. The key to this is support.

The field of logistics is truly the area of the "big re-think" today. No longer can we assume that present operating procedures will be acceptable in the constrained shock army emerging on the horizon. To match this agile, effective, timely shock force, we must tailor a logistics scheme with comparable speed and effectiveness. Using giant jet aircraft, rapid deployment logistics ships, and reliable utility and heavy lift helicopters, we will have to institute a new concept of a mobile logistical pipeline with a flexible "hose" capable of squirting support directly to the user at the moment that it's needed. This will call for processes that allow units to transmit their support requirements instantaneously to the source of support. It will call for processes that allow that support source to sift incoming requests rapidly to assign priorities when this would seem necessary. It will call for processes, in summary, which enable the delivery of support with unprecedented speed and ease to match the momentum of shock combat units. Thus, our combat service support system effort, called CS_3, relies heavily on automatic data processing and information assessment techniques and the entire logistics capability must be supported by extremely responsive communications linking the logistics hose with the combat force.

Underlying the entire concept of agile and effective shock forces in all the activities or phases of battle is the requirement to *conserve* our power sources, command apparatus, and freedom of choice or initiative. The conservation of resources is especially significant when viewed again in terms of cost tolerance levels dictating the investment base for our national defense. The shock force that places a premium on agility, on effectiveness, and on timeliness in constrast to sheer mass is by its very nature exceptionally oriented toward conserving its resources.

The most priceless resource is, of course, the human one. Over the years we have been inclined to think of the combat infantryman as "the lone man at the end of the line." There is a compelling drama to this symbolism, involving as it does the courage and spirit that, when all is said and done, is the final determining factor in our combat effectiveness. Nevertheless, I think the Army of the 1970s will be bringing some transformations in the ways and means of conducting battle that will greatly modify the imagery in "the lone man at the end of the line."

This is because, as we move closer to the agile and effective shock army, we are going to see some phenomenal progress in our ability to *conserve* the lives of our men. The basic role of the infantry—to seize and hold—will remain the same, but the way this role is performed is in for startling innovations and modifications.

The role of man in battle will be changed—not because machines have been substituted for him—but because *machines* and *technology* have *increased* his *effectiveness.* He will be able to stand off and strike lethal blows at the enemy, all the while retaining an unprecedented high degree of survivability.

Man will have to find the enemy, but he will have technology to help him to do this and to conserve his vital energy.

Man will still have to fix the enemy, but he will enjoy the use of agile, effective weapon systems to make that *fix* at stand-off distances.

The fighting will be done, not by man protected only by the shirt on his back, but by these same weapon systems that increase his striking power while reducing his vulnerability.

I have spoken of some of the modernization programs and objectives that will, I believe, be essential to the future of the Army of the 1970s. We face a grave threat and the cost tolerance of this nation provides an increasingly austere investment base, with which to counter that threat.

We must create, then, a force capable of meeting the threat of shock through mass.

This is the role of those of us in the Army charged with charting that course—to design a modernized shock Army keyed to the nation's cost tolerance.

I am confident we can do exactly this by keeping our eyes on this simple equation—*agility plus effectiveness equals shock.* That really says it all.

Naval Ordnance Laboratory

From Concept to Hardware

Dr. Gregory K. Hartmann

A metal that remembers its shape.

An explosive that sets the Apollo crew on the moon.

An antisubmarine missile that goes from underwater to air to underwater.

Glass that gets stronger in the sea.

These are just some of the developments that have come from the Naval Ordnance Laboratory (NOL) at White Oak, Silver Spring, Md.

For 50 years the laboratory has conducted a program of warfare analysis, research, design, development, test, evaluation, systems integration, and fleet engineering support in weapon systems, principally in the areas of surface and undersea warfare. It has also conducted investigations into related fields of science and technology.

A staff of approximately 3,000 and a budget of $70 million permits pursuit of weapons development from the most basic studies to the point of readiness for fleet use. A portion of each year's budget is allocated to independent research—self-directed inquiry into problems of aeroballistics, chemistry, mathematics and physics that have a relevance to eventual military objectives.

NOL is under the administrative control of the Naval Material Command (NAVMAT), and receives 13.6 percent of its funding from its parent organization. Over 70 percent of its support comes from the various NAVMAT systems commands; the balance from the Air Force, the Army, Defense Atomic Support Agency, National Aeronautics and Space Administration, and miscellaneous sources.

The laboratory is headed by a military commander and a civilian technical director, with the commander responsible for the overall operation of the laboratory, and the technical director for the conduct of the technical programs.

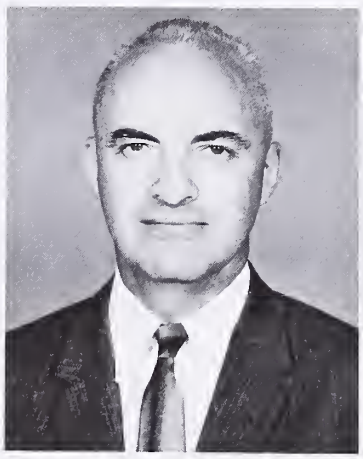
Organizationally the laboratory is arranged into two research areas, two engineering development areas, and two principal support areas, each under an associate or assistant technical director. Three staff groups—the management staff, the personnel office, and the advanced planning and analysis staff—report directly to the technical director and commander.

Below these broad areas of management, the laboratory is organized into departments by scientific and engineering disciplines.

In addition to the plant at White Oak, NOL maintains three major field facilities which are used to help determine the reliability of prototype weapons under actual sea conditions. Evaluation of mines and air-dropped weapons is done at Solomons, Md.; mines at Fort Monroe, Va.; and mines, air-dropped and underwater launched weapons at Fort Lauderdale, Fla.

Throughout its 50-year history, NOL has developed a partnership with industry in the performance of its mission by using commercial products, by encouraging industry to pick up the research and development where NOL leaves off, or by industry participation on the development and production team.

In its search for a non-corrosive, non-magnetic material for tools for underwater repair of magnetic apparatus, NOL led in the development of a new class of non-magnetic metals. From this independent research has come an amazing metal called nitinol —the metal with a memory. An alloy of titanium and nickel, nitinol's properties can be varied by changing the proporton of nickel and titanium, or through the addition of other alloying elements. In one form, nitinol wire can be bent, coiled, or crushed and, if



Dr. Gregory K. Hartmann has been Technical Director of the Naval Ordnance Laboratory since 1955. He has served at NOL since 1946, first as head of the Explosives Department and later as Associate Technical Director for Research. He holds a B. S. degree in physics from the California Institute of Technology and was a Rhodes Scholar at Oxford University, where he received a B. A. degree in mathematics with a special subject in relativity. He received his Ph.D in physics from Brown University.

moderately heated, will return to its original shape.

This feature makes the wire attractive for many commercial uses such as self-erectable space structures, thermally actuated devices (fire and safety devices), self-actuating fasteners, and the principal component of heat-mechanical energy converter (the repeating cycle heat engine).

NOL continues its interest in nitinol research, but much of its further development and all of its production is being conducted now by industry.

Glass that gets stronger in the sea is another example of the way industry and NOL have teamed up to develop new materials.

NOL pioneered the use of glass for submersibles and sought ways to strengthen glass to make a suitable material for moisture-contacted structures. Industry has been doing the same thing.

Surface-compression strengthening by ion-diffusion has resulted in a glass that *gains* in strength after immersion in the sea. To determine if these methods of strengthening did indeed increase the strength of the glass, NOL conducted a recent series of tests. Five types of commercial glass, each strengthened by the manufacturers' own ion-diffusion processes were used. Test results showed an increase in "design-allowable" strengths of at least 6 percent, and in one material of 46 percent.

Tests were conducted in the ocean for 18 months and for 3 years in the laboratory at NOL in circulating simulated sea water. Specimens were held at constant bending stress from 20 percent to 70 percent of the average ultimate bending strengths of the materials.

The specimens were bent in a strong arc throughout the exposure periods. All sprang straight after release, with no evidence of cold flow.

The results of these tests point to future use of surface compression strengthened glass to form many structures, vehicles, or devices for use in a marine environment. Industry, as well as the Navy, can find many uses for such a construction material.

Not all work performed by NOL is done for the Navy. Money from NASA enabled NOL to develop hexanitrostilbene—a stable explosive

Key Personnel Directory

U. S. Naval Ordnance Laboratory

White Oak
Silver Spring, Md. 20910
Phone: (301) 434-7200

Commander—Capt. G. G. Ball, USN

Technical Director—Dr. G. K. Hartmann
Advanced Planning & Analysis Staff—Dr. C. M. Schoman Jr.

Assoc. Tech. Director & Head, Research—Dr. D. F. Bleil
Applied Physics Dept.—Dr. W. W. Scanlon
Physics Research Dept.—Dr. Z. I. Slawsky
Chemistry Research Dept.—Dr. A. Lightbody
Explosions Research Dept.—Mr. C. J. Aronson

Assoc. Tech. Director & Head, Aero- and Hydroballistics —Dr. R. E. Wilson
Aerodynamics Dept.—Dr. L. Schindel
Ballistics Dept.—Dr. A. E. Seigel
Mathematics Dept.—Dr. E. K. Ritter

Assoc. Tech. Director & Head, Air and Surface Weapons Development—Dr. J. S. diRende
Air & Surface Mechanical Engineering Dept.—Mr. J. H. Armstrong
Air & Surface Electrical Engineering Dept.—Mr. E. M. Williams
Air & Surface Evaluation Dept.—Mr. R. E. Grantham

Assoc. Tech. Director & Head, Underwater Weapons Development—Mr. W. B. Anspacher
Underwater Mechanical Engineering Dept.—Mr. C. F. Bowersett
Underwater Electrical Engineering Dept.—Dr. E. H. Beach
Underwater Evaluation Dept.—Mr. J. M. Martin

Asst. Tech. Director & Head, Engineering Support—Mr. P. J. Martini
Environmental Evaluation Dept.—Mr. V. M. Korty
Engineering Services Dept.—Mr. E. H. Langenbeck
Product Engineering Dept.—Mr. H. H. Varhus

Assistant Commander & Asst. Tech. Director & Head for Administrative & Logistic Support—Capt. R. Ennis, USN
Public Affairs Office—Mr. G. F. Kahne

[Editor's note: This listing includes only those key personnel of NOL considered to be of most interest to industry.]

with a formidable name. Because of NOL's expertise in the field of explosives, NASA requested the laboratory to recommend or develop an explosive suitable for use in the seismic experiment package that is to be used in its study of the lunar surface. It must be stable enough to stand the journey to the moon and to remain in the moon's rugged environment with its extremes of temperature, without evaporation or detonation before signal. The explosive, called HNS for short, will be used by NASA for the seismic testing in an upcoming moon mission.

However, it has already been of considerable benefit to the Apollo program—triggering the release of the landing gear of the lunar module to assure a soft landing; separating the ascent stage from the descent stage to permit the return of the lunar module to the command module; and after the astronauts were safely abroad the command module, separating the lunar module and setting it adrift in space.

Aside from space use, as a device to get things to operate, HNS offers a potential to the oil industry. Deep oil wells need a thermally stable explosive to start the flow of oil. HNS may prove to be the answer to these needs.

Phase Plan

The laboratory is annually engaged in the development of weapon systems, subsystems and components to the extent of 69 percent of its budget. It owes much of its success in the area to the Phase Plan, an orderly process whereby a project proceeds by discrete steps from design to production (Figure 1).

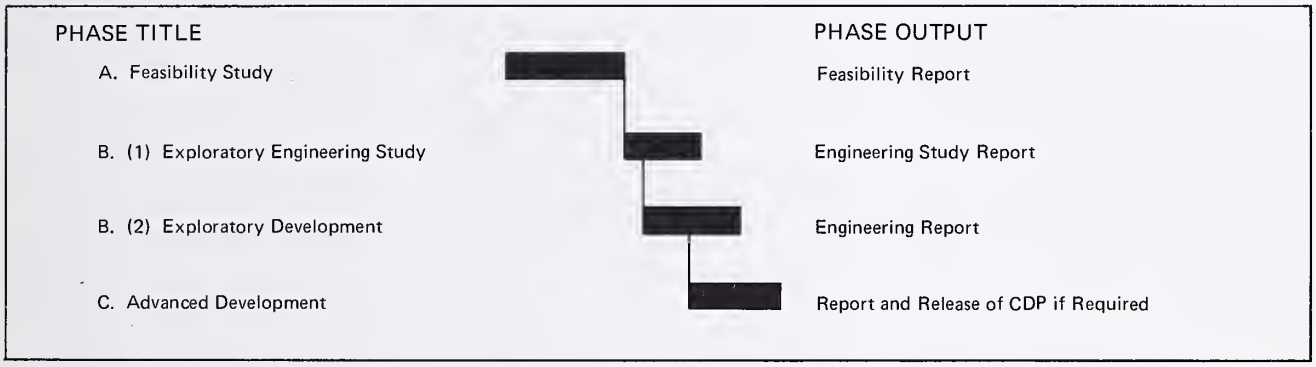
Before undertaking a major project, a feasibility study is made, particularly in the development of a new weapon or weapon system which depends on a combination of new principles, or which may satisfy a new tactical need.

This is mostly a paper study, with as little experimenting and testing as necessary. Its aim is to determine two things—is the weapon or system feasible, and is it desirable?

The proposed weapon or system is assessed at a reasonable level of confidence to determine if its characteristics are attainable within acceptable limits.

The value of the target (or the

NOL Phase Plan: Part I



NOL Phase Plan: Part II

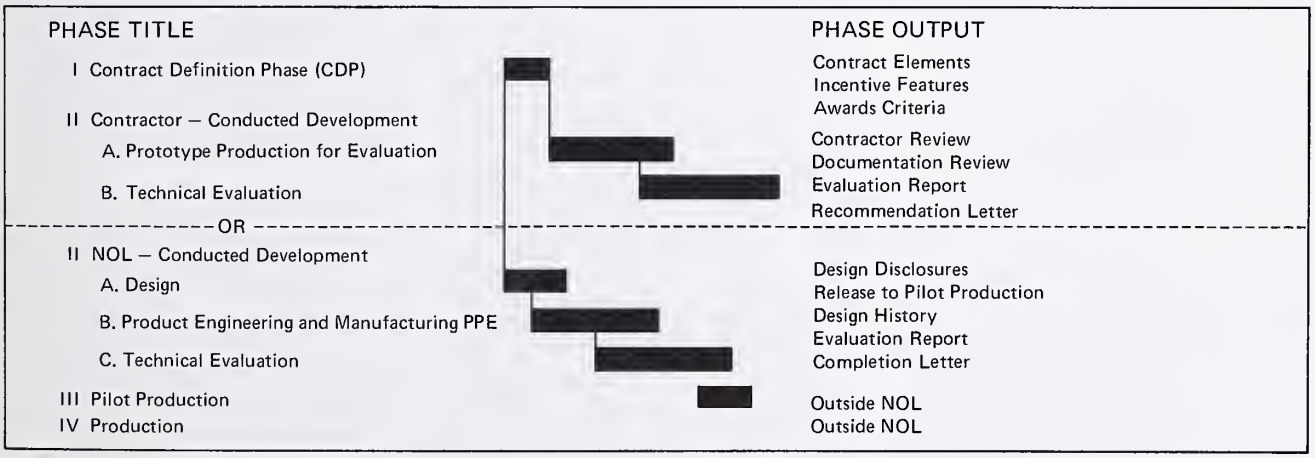


Figure 1

magnitude of the threat) should be compatible with the effort required to develop and deploy the proposed weapon. It should furnish a capability not now in existence or should do a better job than some existing weapon, with sufficient cost-effectiveness margin on this preliminary study to indicate an engineering study has reasonable prospects for a worthwhile pay-off.

The exploratory study and development, which is divided into two parts, takes the study of the project into greater depth.

The exploratory engineering study is a follow-on of the feasibility study and has as its purpose to:

- Make a fine-grain assessment of the key problems highlighted in the feasibility study, and to devise technical approaches for the solution.
- Establish in some detail a proposed weapon profile or performance envelope.
- Put tradeoff and cost-effectiveness studies of the feasibility study on a more quantitative footing in the light of the first two aspects of the exploratory engineering study.
- Formulate a detailed plan for the exploratory and/or advanced development which must be conducted to find solutions to the key problems prior to engineering or operational system development.

Exploratory development is typically composed of analytical studies, preliminary designs, and laboratory and field demonstration (often on a scaled basis) of the feasibility of tactical usefulness of a system. Hardware development extends only to the breadboard or experimental model stage.

For major systems, advanced development is conducted, with production of engineering prototype models and full or realistic scale testing in all key areas.

The results of the exploratory and advanced development phases are submitted to the Chief of Naval Operations in a report package, giving the elements needed to proceed with the contract definition phase.

From this information it will be determined whether development of the project will be conducted by NOL or by contract. If by contract, and in certain cases if by NOL, the project goes through a contract definition phase, in which a formal proposal is prepared by the contractor (or NOL if performing the development).

The contract definition phase is the usual entry point for a contractor into the project. However, exploratory or advanced development can be performed with contract assistance. If this is the case, NOL serves only as a consultant to the contractor in the contract definition phase, whereas normally NOL monitors the contractor output during this phase.

When the project gets to the development phase, it is expected that there will be little change in the objective specifications for the weapon characteristics.

For contractor-conducted development, NOL provides contract monitoring by reviewing:

- Technical approach and development progress.
- Performance for pay-off.
- Design documentation.
- Assembly and operation publications.

NOL also serves as trouble shooter, and normally is responsible for technical evaluation of the prototype.

It is essential that when the laboratory is assigned monitor, trouble-shooter, or technical evaluation responsibilities, the contract with the developing contractor must be explicit in detail as to the laboratory's functions in order to avoid the charge of interference. Likewise, hardware requirements to carry out the laboratory's plan for technical evaluation should be clearly written into the contract.

Even when the development is carried out in-house by NOL, contract assistance is still usually required. Contracts for component or module development are awarded and technically directed by NOL.

Proof of the pudding is in the eating. After development has been completed, prototypes need to be evaluated. Whether NOL or the contractor has performed the development, NOL prepares the plan and conducts the technical evaluation.

Contracts for technical evaluation of hardware are awarded by NOL and receive NOL technical direction. Contracts for prototype production for evaluation may or may not be awarded to the same contractors used for the development.

Having passed NOL technical evaluation, the project is released for pilot production. NOL prepares a report and the release letter to the sponsor.

Technical data (drawings, specifications, quality assurance provisions, etc.) are prepared by NOL or by contract at the discretion of the laboratory. These documents are reviewed for product engineering, technical completeness, and accuracy and soundness of design. Publications covering the weapon description, assembly, test and checkout, operational use, etc., are prepared by NOL or by contract under NOL direction. This data is available to the pilot production and production contractors.

Project Responsibilities

Who is responsible for seeing that a project runs smoothly, is finished on time, and that the hardware functions as it should and meets all requirements?

Under NOL's present functional organization, one segment of the laboratory is expected to contribute the major effort in the development of a project. It is named the "lead segment," and its chief is responsible for seeing that the project is carried out.

However, in the case of major projects requiring effort from more than one of the discipline areas, it is essential that coordination be effected between the areas. For such a project a full-time staff assistant, or project manager, is assigned to the lead segment. He serves as the focal point in the laboratory for the project, and coordinates the project internally and externally. He is the laboratory's official spokesman and the contact for contractors and organizations outside Navy.

It is the project manager who charts the course of the project, making all plans of action and approach, and budgeting for personnel needs. He is responsible for preparing recommendations for release of the project to the laboratory management when the time comes for contract development or production work. He is, therefore, the man most closely in

(*Continued on page 29.*)

Risk Analysis

John D. Hwang
James L. Arnett

On July 31, 1969, Deputy Secretary of Defense David Packard sent a memorandum to the Secretaries of the Military Departments, highlighting major problems in weapon system acquisition and outlining current administration policy with respect to improvements.

The Army action plan to implement Secretary Packard's guidance extended the improvement program to the entire materiel acquisition cycle, and addressed overall program management. The largest areas of responsibility were under the Army Materiel Command (AMC), which devised a program called "Program for the Refinement of the Materiel Acquisition Process" (PROMAP-70). PROMAP-70 is being directed by Major General Paul A. Feyereisen, AMC's Deputy Commanding General for Materiel Acquisition. [See article, "PROMAP-70," by Major General Feyereisen, *Defense Industry Bulletin*, August 1970, page 18.]

Two of the tasks identified under PROMAP-70 as needing improvement were analysis of technical risk and cost estimating.

The following two articles discuss these subjects as they are being addressed under the program.

Analysis of risk is not new to the military services. However, the formal presentation of an in-depth study called a risk analysis *is* new. The latter is now a way of life for project managers in the Army Materiel Command (AMC).

Analysis of technical risk is one of the tasks of AMC's PROMAP-70 program. The objective of this task is to improve the analysis of technical risk so that cost growth does not result from prolonged development and from changes required to overcome technical problems. This objective is achieved by:

- Prototype demonstrations.
- Technical audits.
- Back-up development of high-risk components.

A necessary prerequisite to the developing of a capability to analyze technical risk was initiation of a training program. This task was assigned to the Army Logistics Management Center (ALMC) at Fort Lee, Va.

The scope of the effort that is being made to educate certain people in techniques and ways of doing risk analysis is broad. A logical question might be, why so much emphasis on this particular area, when there are so many other areas in logistics where attention is required? The answer to this question is quite involved.

To start with, proper executive decisions in any field require that the best possible information be provided the decision maker. However, in the case of a decision on a major weapon system, the requirement is significantly more stringent, in that the fate of the nation could well depend upon the outcome. Further, economic considerations also have great impact. Waste in Government has always been deplored. But, under present conditions, with large investments in heavy weapon systems and increasing requirements in the public sector, public reaction to military spending is such that no effort must be spared in ensuring that we get the greatest value for each defense dollar spent. Risk analysis is one tool which, when used correctly, can provide necessary information for decision making under such conditions.

What is the nature of this tool and is it new? Well, for some time the Defense Department has emphasized the use of quantitative methods in the process of executive decision making. By now, this movement has reached most levels of management in the military services. The most fashionable name for these techniques for the past few years has been *systems analysis*. For example, Alain Enthoven, one of the leaders in systems analysis under former Secretary of Defense McNamara, stated in *A Modern Design for Defense Decision** that systems analysis analyzes alternative objectives and explores their implications.

It is, therefore, clear that *risk* analysis and *systems* analysis are

* *Alain C. Enthoven, "Operations Research at the National Policy Level," in* A Modern Design for Defense Decision, A McNamara-Hitch-Enthoven Anthology, *edited by Samuel A. Tucker (Washington, D. C., Industrial College of the Armed Forces, 1966).*

John D. Hwang is a research mathematician in the Systems Analysis Directorate, Army Weapons Command, Rock Island, Ill. Previously he served as special assistant to the Deputy Commanding General, AMC. He has also worked as a research engineer for several state and Federal agencies. He holds a B. E. E. degree from the University of California, Berkeley, and an M. S. in applied mathematics and Ph.D. in mathematics and systems engineering from Oregon State University.

very similar. If not the same family, they are at least the same tribe. There are some basic differences, but they are more related to techniques and methodology than to the purpose of the analysis. In fact, one could be considered as a subset of the other. The choice as to which is which would depend on the viewpoint of the evaluator. The discussion in this article will indicate how risk analysis has a close affinity to systems analysis and that it adds a new dimension to the acquisition process.

With the constant need to make management decisions on some quantified basis, emphasis on systems analysis in DOD began the McNamara era, in 1961. The theme of McNamara's system analysis was that defense is an economic problem in the efficient allocation and use of resources. He introduced what has been termed the 3-phase operation: planning, programming, and budgeting. Planning involves cost-effectiveness analysis. Heavy reliance has been placed on systems analysis in the consideration of questions such as how much is enough, how should resources be allocated, and what tradeoffs among doctrine, weapons, equipment, etc., are feasible in the achieving of defense posture. All in all, systems analysis has been denoted as "quantified common sense" and used to provide "synthetic experience." Systems analysis/systems engineering can be defined as an explicit logical examination of alternatives by estimating and comparing the impact of each alternative on the cost and/or effectiveness of a given system without violating exogeneous constraints imposed on the system under study. One school of thought juxtaposes systems analysis and system engineering by establishing system performance objectives versus design criteria for system elements.

A significant part of the activities of DOD involves weapons development and production, or as we know it, the weapon systems acquisition process. This process includes four phases: concept formulation; contract definition; research, development, test, and evaluation; and production. It emphasizes the flow of decisions and activities, including actions, reactions, and interactions of government agencies and defense contractors. Decision analyses are required at all echelons of the defense organization regarding factors that affect the cost, time of availability, and performance of weapon programs.

A familiarity with basic terms is a prerequisite to the understanding of any subject, and decision analysis and acquisition management are no exception. For example, a weapon system is defined as a composite of equipments such as an aircraft, a radar unit, or a reconnaissance satellite with supporting gear, any one of which may be employed as entity to accomplish a military mission, such as offsetting a threat of potential advances of hostile bombers to our defense territories. An alternative definition of a weapon system is a set of potential military capabilities. The ability of a weapon system to perform a mission is described in terms of three quantities or dimensions: cost, time, and performance.

Cost reflects the resource commitments required to attack a specific level of potential enemy capability. Time denotes the period during which the weapon system is available for military operations, thereby determining the system's effectiveness relative to the military environment within which it operates. Finally, performance reflects a weapon system's technical quality in terms of system characteristics such as mobility, firepower, communication, and reliability. Reliability is further defined as the probability that the system can sustain its technical performance potential.

A weapon system program decision is defined as the decision to undertake and commit resources to the development of a specific weapon system. A multiplicity of technical, military, financial, and scheduling decisions determines the course of a

James L. Arnett is Chairman, Cost Estimating and Analysis Department, School of Logistics Science, Army Logistics Management Center, Fort Lee, Va. He has been an instructor in Army logistics courses and director of operations research for a private corporation. Mr. Arnett holds a B. S. degree in chemistry from the University of Arkansas, and an M. S. in mathematics from Virginia State College.

typical weapon program. In actual program decisions, uncertainties are very real, and sometimes determining, complications. A closer definition would state that a weapon system program decision is a decision made under uncertainties much greater than normally encountered.

In defining acquisition management, we observe first that management *per se* is the process of converting information into action, while *acquisition* management constitutes an information feedback loop.

Acquisition management is a complex, multi-loop and interconnected system. Decisions are made at multiple points throughout the system, with each resulting action generating information that may be used at several but not all decision points. This structure of cascaded and interconnected information-feedback loops, when taken together, constitutes the management process. The interlocking network of information channels emerges at various points to control physical processes. Every action point in the management network is backed up by a local decision point whose information sources reach into other parts of the organization and the surrounding environment.

A weapon system program decision involves the interrelationship of four fundamental elements: external threat, cost, state of the art, and time. The existence of an external threat is the *raison d'être* for weapons development. Cost enters into the program decision as a constraint. The state of the art constitutes a further constraint upon a nation's ability to deal with the external threat, at any particular point in time. As time passes, increases in the nation's stock of knowledge can be expected to offset to some extent the prior inability to deal with the external threat. The interaction between time, the growth of technical knowledge, and the external threat is therefore significant.

Historically, it has been imperative to exploit quickly all significant advances in the state of the art, in order to maintain the qualitative superiority, or at least parity, of the weapons inventory. This quickness implies the decision to begin development after technical feasibility is predicted, or at some time soon thereafter. Development lead time (the time interval between decision to begin development and ensuing operational availability of that weapon) is then dependent upon the amount of resources allocated to the development effort.

Past problems in cost growth, schedule slippage, and degradation of performance during the course of the weapon system acquisition process led to a search for a way to assess the probability of program success, and to control program problems. This assessment of program success constitutes the basis for the *risk analysis* of a program or project.

Uncertainties exist and affect the three dimensions of cost, time, and performance. A risk analysis is merely an extension of systems analysis to determine tradeoffs among these three dimensions, except that a fourth dimension of *risk* is introduced. This latter factor is used as a common measure to integrate the three dimensions. Hence, risk can be defined as the probability that the weapon system will fail in at least one of the following ways:

- Achieving the specified performance.
- Meeting the time constraint.
- Meeting the cost constraint.

Risk analysis can thus be envisaged as the *systems analysis of risk*.

As the basic objective of risk analysis is to create a quantitative and experimental laboratory to study the probability of program success, the general methodology for a risk analysis is quite similar to the steps involved in systems analysis, systems engineering, or industrial dynamics. The steps include:

- Identify objective.
- State the alternatives.
- Collect the data.
- Construct the model.
- Simulate.
- Validate the model.
- Obtain the criteria and establish trends.

Under the general methodology, the basic scheme for risk analysis is shown in Figure 1. We begin with the identification of the levels and details of the analysis. Next, all system candidates under consideration are noted. We detail out all uncertainties which could affect the three dimensions. We then collect data which are normally in two forms: objective—available data from testing, data bank, or previous studies; subjective—judgmental values ob-

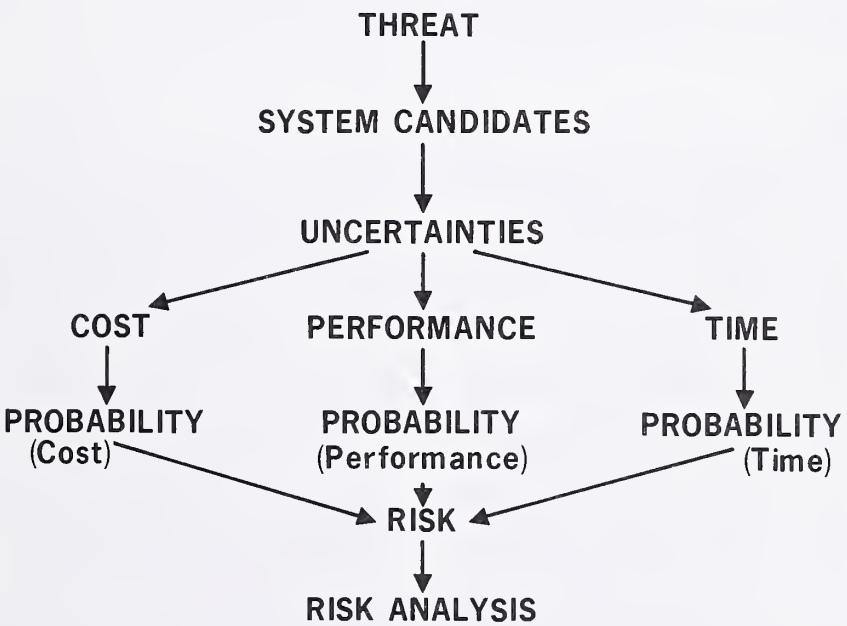


Figure 1.

tained from experts in the field under consideration.

It is now necessary to obtain probability distributions of performance, cost and time to completion and to construct the model to combine the probability values to calculate risk for each set of values of cost, time, and performance. It is also necessary to compute tradeoffs among these factors from simulations, to obtain criteria and trends as recommendations for decision analysis. Furthermore, sensitive elements or parameters and high risk areas are identified so that those critical areas are carefully monitored. Unfortunately, the necessary validation phase may not be possible until such time as actual test data are generated, or at regular update intervals.

In 1969, the Aerospace Industries Association (AIA) initiated a massive effort to uncover the problem of relating uncertainties in weapon system development. In identifying the essential technical steps, AIA found that there has been much similarity in the evolution of programs through uncertainties. Uncertainties fall into two main categories: the things you know you don't know at the start of the program, and things you don't know you don't know. Thus, we have *known-unknowns* for which allowances can be made and *unknown-unknowns* (unk-unks) for which one is unable to plan. Ideally, of course, we should quantify each uncertainty.

In these days of stringent budgetary restrictions, it is necessary that we ask ourselves whether or not resources devoted to risk analysis contribute to improved acquisition management. The answer is that significant payoffs include identification of high risk areas, so additional studies can bridge these gaps in the decision-making process, as well as enabling us to evaluate the sensitive and critical parameters which must be most carefully monitored. One added fallout benefit of risk analysis is to train all acquisition management personnel to become more conscious of system risk. Appreciation of risk by all levels of acquisition personnel should increase the probability of project success by contributing to the control of cost growth, schedule slippages, and degradation of performance. Finally, the quality of individual risk analyses will improve as the subjective type data provided by enlightened acquisition personnel improves.

Cost Estimating Techniques for Systems Acquisition

Major Paul R. Herholz Jr, USA

Under PROMAP-70, a profile study was made of the Army Materiel Command's capability for cost estimating and cost analysis. The results of the study evidenced the need for additional personnel, cost data centers in each commodity command, and formal training of personnel involved in cost estimating and analysis.

The Army Logistics Management Center (ALMC) was tasked to develop several new courses of instruction to assist in the accomplishment of specific tasks included in PROMAP-70. The first requirement was a course in life-cycle cost estimating.

This article introduces some cost estimating concepts taught Army Materiel Command (AMC) military and civilian cost estimators at ALMC.

Estimating Methods

Research in the field of cost estimating determined that, although numerous variations exist, there are basically three methods used for cost estimation—industrial engineering, analogy, and statistics. However, mention must be made of a fourth factor, the use of expert opinion.

This quality is an essential element in any approach to the cost estimation of complex materiel systems.

Research indicated that quantitative methods, *i.e.*, statistical and some operations research techniques, should be emphasized in AMC cost estimating and analysis. It became evident, however, that the qualitative or subjective factors which influence a

Major Paul R. Herholz Jr. USA, is the Director, Cost Estimating Techniques for the Systems Acquisition Course, at the School of Logistics Science, Army Logistics Management Center, Fort Lee, Va. He holds a B. S. degree in business management from Kent State University, and an M. S. degree in business statistics from the University of Alabama.

system's cost should also be considered. Regardless of the quantitative technique used, it is not possible to predict future events—in this case, cost—with certainty. Knowledge of the qualitative factors involved is essential to a basic understanding of the scope and complexity of the cost estimating problem. In addition, this knowledge assists an estimator in judging the validity of his analytical estimates. As a result, the cost estimators must consider both the quantitative techniques and the qualitative factors involved in predicting the life-cycle cost of a system.

Awareness of several qualitative factors is necessary for a well rounded understanding of the cost estimating problem. These include technical knowledge of those procurement policies, procedures, and techniques which influence a system's cost. AMC cost estimators are given information relevant to cost from the areas of contract definition and source selection, pricing policy and technique, contract pricing arrangements, negotiation, cost reduction, and the "should cost" concept.

Basic Assumption

The basic premise of all the techniques is that a cost estimate can be developed formally on the assumption that experience is a reliable guide to the future. In the simplest case the guidance is clear, such as the cost of off-the-shelf commercial items. At a slightly more sophisticated level, average costs can be calculated and used as factors to estimate, *e.g.*, the cost to drive a tracked vehicle a mile or fly a helicopter for an hour. A great deal of estimating is of this general type —the relationship between past experience and future expectation is fairly obvious.

The problems which are of most concern, however, are those in which the relationship between the past and the future is unclear, because the new item differs in some significant way from its predecessors. The challenge to AMC and industry cost estimators is to project from the known to the unknown, and to use experience gained on existing equipment to predict the cost of equipment of the next generation.

The statistical technique of regression analysis can often be used, when relevant data is available, to predict the costs of components of a new system and, in some cases, the entire hardware cost. The technique can be used when it is felt that a relationship exists between a physical characteristic of the component or system and the cost of the component or system.

Figure 1 shows an example of the basic concept of regression analysis. In the example, the relationship between the independent variable (vehicle gross weight) and the dependent variable (POL cost per mile) is linear. Functional relationships, such as the one illustrated, are called cost estimating relationships. As an illustration of how this particular example would be used, suppose that we were planning to build a 10,000-pound truck. Assume that we hadn't done this before, but that the new vehicle is within the range of our experience as far as weight and POL cost are concerned. A rough estimate of the POL cost per mile could be read directly from the graph. A more accurate estimate could be obtained by using the formula for the regression line (trend line) which in the linear case is of the form $Y = a + bx$. For this particular example the formula is $Y = .93 + .000079$ (gross weight). By substituting 10,000 for X, and solving the equation, we arrive at our estimated POL cost of $0.0172 per mile for our new vehicle.

A complete regression analysis is much more complicated than indicated by the brief discussion presented thus far, but is standard subject matter in statistical literature.

The principles involved in the simplest form of regression analysis, *i.e.*, where the relationship between cost and some other variable is linear, can be expanded to explain the case where the relationship between cost and an independent variable is not linear (curvi-linear regression); and to explain the case where more than one independent variable is used to explain cost (multiple regression). As an example of this last case, and referring to our previous example of vehicle weight and POL cost, we may find that weight does not adequately explain POL cost per mile. We then search for additional explanatory variables. One possibility might be engine horsepower. If we wish to use both

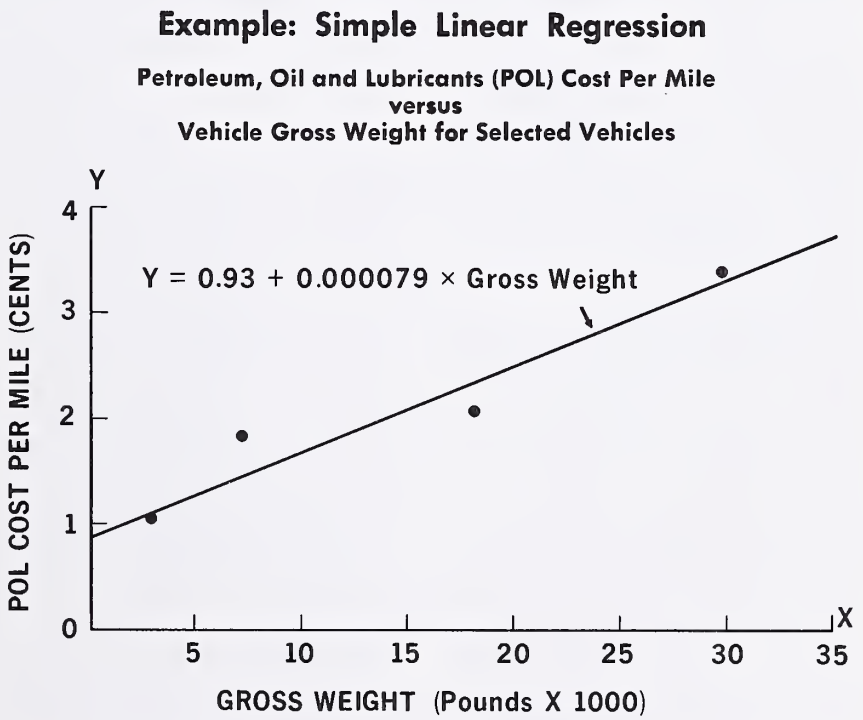


Figure 1.

weight and horsepower, our model is of the form

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2,$$

where X_1 is vehicle weight and X_2 is vehicle horsepower. The solution for this particular example is

$Y = 1.4 + .000137$ (gross weight) $+ .011$ (horsepower).

This model (or any other model) can be tested to determine if a statistically significant relationship exists between cost and the independent (explanatory) variables used in the model.

Curvi-linear and multiple regression problems can become extremely difficult to handle analytically if a complex model is established. Since the basic principles of the analysis remain the same regardless of the particular model used, our approach in the course is to ensure that the AMC cost estimator understands what he is doing and then show him how to use a computer to perform the mathematical portion of the analysis.

The basic problem for the estimator, then, is to find one or more variables and the functional relationship which explains the cost of his system or components of his system.

Regression analysis is not, however, a panacea for cost estimating. The models established must be based upon a logical relationship between the independent variable(s) and cost. In addition, accurate historical data must be available. Unfortunately, accurate relevant data is not always available. This is particularly true when the system under development represents significant state-of-the-art advancements.

In addition to its role as a tool for analyzing cost estimating relationships, regression analysis is an integral part of learning curve theory. The learning process is a phenomenon that exists in many industries; empirical data and controlled tests have verified its existence. The basic hypothesis of learning curve theory states that each time the total quantity of items produced is doubled, the cost per unit is reduced to a constant percentage of its previous cost. Alternative forms of the theory consider the unit cost of producing an item at a given quantity or the average cost of producing all items up to a given quantity. For example, if the cost of producing the 100th unit of an item is 90 percent of the cost of producing the 50th unit, and if the cost of producing the 200th unit is 90 percent of the cost of the 100th unit, and so on, the production process is said to follow a 90 percent unit learning curve. If the average cost of producing all 200 units is 90 percent of the average cost of producing the first 100 units, the process follows a 90 percent cumulative average learning curve.

The use of learning curve theory to predict unit cost is particularly appropriate when non-standard items are involved and when the direct labor requirement is a substantial portion of the production cost.*

Industrial Engineering Technique

The industrial engineering technique is also considered to be one of the principal approaches to cost estimating. Estimating by industrial engineering procedures can be broadly defined as the examination of separate elements of work at a low level of detail and the summation of the many detailed estimates into a total cost. The estimator begins with a set of drawings and determines each engineering task, tool requirements, production operation, and the labor and material involved. The name and number of the operations and the machines that will be used must be determined, together with estimates of set up and operating time and labor cost. Standard set up and operating costs are used if they exist. If standards have not been established, a study is made to determine the most efficient method of performing each operation.

The detail estimator works from sketches or word descriptions of some item that in many cases has not been completely designed. As such, he suffers from the same disadvantages as do all other estimators before an item has been produced. Costs can be assigned only to work that is known. An attempt is sometimes made to apply factors to a detailed estimate for such costs as rework, planning time, quality control, manufacturing research, etc. The factoring process has the disadvantage that small errors in the detailed estimate can result in large errors in the total.

Since a private firm usually has only information on its own products, much estimating in industry is based on analogy. Engineers and foremen may rely on analogies when making detailed estimates; in this case, analogy becomes part of the industrial engineering approach.

Industrial engineering estimating procedures require a considerable number of people and extensive data. The technique is costly and time consuming. In addition, it has been found that for many purposes the industrial engineering technique produces results that are less accurate than estimates made statistically. One reason is simply that the total often is greater than the sum of the parts. There will always be cases in which industrial engineering and/or analogy approaches are required, but in general statistical methods are more useful, whether the purpose is long-range planning or contract negotiation.

At Concept Formulation

The most difficult point of time in which to apply a quantitative approach to cost estimating is in the concept formulation stage of a new system. At this time, the least detailed information is known about the project. One technique that considers this problem utilizes network theory, a variation of PERT (Program Evaluation and Review Technique); subjective probability; and simulation. In the concept formulation stage, it is not always possible to identify all the activities necessary to complete the project. The technique taught at ALMC considers the fact that some activities are uncertain and provides a means to analyze the effect of tradeoffs when desired activities prove to be unfeasible. Empirical data may not be available for estimating the probability of success and cost for many activities involved in a new project. One is forced to use a Bayesian approach, *i.e.*, subjective probability estimates for such

* *See article, "Predicting Production Costs with Learning Costs," Wiley F. Patton,* Defense Industry Bulletin, *November 1969, page 5.*

activities. Since the value of the simulation for predicting a system's cost is proportional to the accuracy of the activity probability statements, it is of the greatest importance that the best information and professional judgment possible be used in the development of the activity probability statements. Empirical data should, of course, be used whenever possible.

Since the technique is based primarily on subjective probability, the results must be critically examined in conjunction with whatever additional information is available at the time. However, as a minimum, the technique reveals time and cost limits for any specific approach to project development. In addition, the procedure requires a systematic approach to planning the materiel system under consideration and analysis of expected areas of difficulty.

Sensitivity Analysis

A life-cycle cost estimate for a complex materiel system will contain a large number of cost factors. The accuracy of the cost estimates for some of the factors will have little effect on the accuracy of the total life-cycle cost estimate. However, the variability of other cost factors may greatly affect the total system cost estimate. The most important cost factors (in terms of effect on life-cycle cost) are identified by the use of a procedure called sensitivity analysis.

Sensitivity analysis in costing is basically the process of examining the cost factors in the system to which an optimistic and pessimistic cost estimate can be applied. The life-cycle cost study is then repeated, keeping every input the same as in the initial estimate except for one input which is given one of its limiting values. The change in the total cost estimate due to the change in the one input is obtained. This process is then repeated for both limits of each input to which limits were assigned. Sensitivity analysis results in a list of investigated inputs showing a ranking of inputs in order of their impact on total system cost. The majority of the validation effort should be applied to those factors identified as having the greatest effect on total system cost.

When the life-cycle cost estimate is completed, regardless of the technique used, an economic analysis of the estimate should be made. This analysis must include the time value of money in the form of an interest rate.

The process of discounting the cost of a system provides a means of comparing competing weapons or materiel systems from a standard cost base, *i.e.*, present value or current fiscal year dollars. Although many factors other than cost are considered in determining a preferred system, a comparison of discounted systems' costs is of considerable value in determining the cost effectiveness of each of the competing systems.

The major advantage of escalating a system's cost is to reveal the total life-cycle cost that will have occurred when the project has completed its life cycle. This information is valuable for fiscal planning. An additional benefit, assuming a fairly accurate rate of inflation is used, should be a reduction of cost growth criticism which occurs as a result of inflation and is sometimes confused with poor planning.

The net result of improved life-cycle cost estimates is a better factual base for intelligent management decisions. It is expected that application of these and other techniques taught at ALMC will result in improved cost estimating by both AMC and industry.

Containerization Program Given Product Management Status

The Army Materiel Command (AMC) has elevated its containerization program to product management status in an effort aimed at ultimate development of a totally integrated containerization system for Army-wide application.

Product management status is reserved for items of equipment or systems accorded special intensive management attention because of criticality of mission, urgency, complexity, or high level interest. Product manager is Colonel Raymond A. Cramer Jr., a transportation and supply distribution expert.

Reporting directly to the Commanding General, Army Materiel Command, the Product Manager for Container Systems has management responsibility for development of materiel and plans, as well as execution of life-cycle pilot operations in supply distribution.

Objectives of the program are:

- To develop a total systems concept, wholesale supply doctrine, plans for supply distribution operations and directive documentation.
- To develop, test, procure, and place into operation containerization systems, including related materials handling equipment, which will provide the Army with an effective and economic containerized logistic distribution capability.

The Army pioneered containerization with its all-steel CONEX (Container Express) fleet 18 years ago. This steel box, about 7 feet on a side, is used for consolidating into a unitized load many small packages. Since May 1969, the Army has had a fleet of leased units of the larger 20-by-8-by-8-foot size for overseas shipments. More recently, AMC successfully demonstrated containerized overseas shipment of ammunition. Efforts are now underway to establish a total containerized Ammunition Distribution System Army-wide.

A development and acquisition program for an Army-owned fleet of inter-modal containers conforming to U.S. and international standards is now in progress and the first production model from a procurement order of 6,700 is currently undergoing tests.

As the Army sees it, a universal containerized logistics distribution system with associated standardized materials handling equipment and documentation procedures can pave the way for "thru-put" supply from depots or factories directly to field units at savings in transportation costs, manpower and with increased efficiency in operations.

Industrial Personnel Security Clearance Review

William J. Scanlon

The Defense Department Industrial Security Clearance Review Office (ISCRO) was established pursuant to DOD Directive 5220.6, "Industrial Personnel Security Clearance Program," to administer the program prescribed by that directive. The office is a component of the Office of the Assistant Secretary of Defense (Administration) which, through the Deputy Assistant Secretary of Defense (Security Policy), provides overall policy guidance for the program. Those officials are responsible for the administration of the ISCRO, including the organization and composition of its various boards, field offices, and staff.

The primary function of ISCRO is to adjudicate the eligibility for security clearance of those persons (called applicants, regardless of whether they are, in fact, new applicants for clearance or persons for whom clearances already have been granted) whose eligibility has been questioned by the Defense Industrial Security Clearance Office (DISCO), a component of the Defense Supply Agency. The Defense Department Industrial Security Regulation places upon DISCO the responsibility for processing applications for industrial personnel security clearances. That includes responsibility for initiating appropriate investigations, reviewing the completed investigations, and issuing clearances (letters of consent) for those applicants whom DISCO determines to be eligible. Cases of those applicants whose eligibility for clearance DISCO questions are forwarded to ISCRO for adjudication.

It is important to note that, although DISCO is authorized to make final determinations favorable to applicants, it is not authorized to make final adverse determinations. Any case which, upon the basis of all available information, DISCO cannot determine favorably under the standard must be referred to ISCRO so that the case may be adjudicated in accordance with the procedures set out in DOD Directive 5220.6. As a practical matter, DISCO refers to ISCRO for adjudication all those cases containing apparently substantial information reflecting adversely upon the applicant's reliability, integrity, trustworthiness, or suitability for a position of trust. Those are the so-called "substantial derogatory information" cases.

All final determinations, whether made by DISCO or ISCRO, and whether in the applicant's favor or adverse to the applicants concerned, are made in accordance with the standard set out in Section V.A. of DOD Directive 5220.6. That section, which derives from Section 2 of Executive Order 10865 titled, "Safeguarding Classified Information Within Industry," reads:

> Access to classified information shall be granted or continued only to those individuals who have been determined eligible based upon a finding that to do so is clearly consistent with the national interest.

Section VI of the directive provides 21 specific criteria for guidance in application of the standard. However, it also provides that ISCRO need not be limited to those specific criteria in making determinations. On the contrary, the ultimate determination in any case must be an overall common sense one, based upon all the information which properly may be considered, including but not limited to, such factors as the gravity of the adverse information involved, its implications, its recency, etc.

William J. Scanlon is Director of the Office of Industrial Security Clearance Review, Office of the Assistant Secretary of Defense (Administration). Before Mr. Scanlon was appointed director in January 1966, he served in ISCRO successively as Security Advisor, Special Assistant to the Chief Department Counsel, and as a member of the old Central Review Board. He is a lawyer and was admitted to the Bar of the U. S. District Court for the District of Columbia in 1940.

The headquarters of ISCRO is in the Pentagon. ISCRO has field offices in New York (Eastern Field Office), Los Angeles (Western Field Office) and Arlington, Va. (Washington Field Office).

The office is composed of a director and an administrative staff; a Screening Board (two panels composed of three members each); five hearing examiners; an Appeal Board (one panel composed of three members); and Department Counsel (a Chief Department Counsel and eight associate or trial counsels).

The Director, the Screening Board, the Appeal Board, Chief Department Counsel and a portion of his professional staff, and the bulk of the administrative staff are located in the Pentagon headquarters of ISCRO. The Eastern and Western Field Offices each are staffed by two hearing examiners, two trial counsels, and two clerical employees; the Washington Field Office by one hearing examiner, one trial counsel and one clerical employee. In each field office, one of the trial counsels also functions as the administrative director of the office.

The flow of cases referred by DISCO to ISCRO is depicted in Figure 1.

A screening board determination in the applicant's favor is a final determination. In those cases, DISCO is directed to grant (or continue) a security clearance for the applicants concerned.

A screening board determination adverse to an applicant is not final. The applicant must be furnished a Statement of Reasons (SOR) prepared by the screening board setting out the basis for its determination. He has the right to submit a written answer to the SOR; an opportunity for a hearing before an examiner; and, ultimately, a right of appeal to the Appeal Board. However, should he fail to submit a timely answer to the SOR, he is denied clearance administratively, without further processing, and any existing clearance is revoked.

Should the applicant submit an answer to the SOR and request a hearing, his case is assigned to an examiner for hearing and determination. Every reasonable effort is made to hold the hearing at a place and time convenient to the applicant. Should the applicant submit an answer to the SOR and waive his opportunity for a hearing, his case is assigned to an examiner for determination upon the basis of all the available information, including the answer to the SOR and any supporting evidence the applicant may choose to submit.

Either the applicant or the Government (department counsel) may appeal the examiner's determination in which event the record in the case, including the examiner's determination, is referred to the Appeal Board for final determination. The Appeal Board sits only in the Pentagon. Appeals may be made by brief or by appearing personally before the Appeal Board to present oral argument. In the absence of timely appeal to the Appeal Board—10 days—the examiner's determination constitutes the final decision in the case.

Screening Board

The Screening Board is composed of civilian and military personnel. It is divided into two panels of three members each. Every case referred by DISCO is submitted to the Screening Board for review and determination. Either panel of the Screening Board may act upon a particular case. Screening Board determinations are made by majority vote of the panel to which the case is assigned by the Director of ISCRO.

The panel to which a case is assigned must make what is basically an "either/or" decision: either enter a determination in the applicant's favor, notwithstanding the information which caused DISCO to refer the case to ISCRO, in which event the determination is final and DISCO is directed to grant (or continue) clearance for the applicant; or enter a determination adverse to the applicant and prepare a Statement of Reasons (SOR) setting out the basis for that determination.

Case Flow

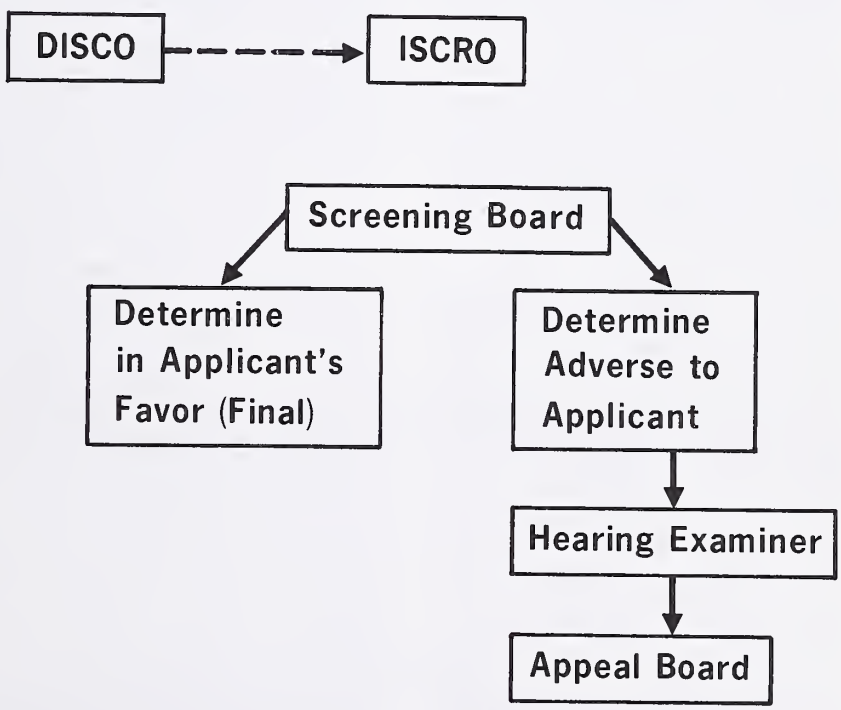


Figure 1.

There is an interim action available to the Screening Board in those cases in which it is not satisfied with the adequacy or clarity of the information available to it. It may request supplementation or clarification either by additional investigation, by interview with the applicant, by ordering a psychiatric evaluation of the applicant, or by other fact finding procedure such as written interrogatories. Ultimately, however, it must either render a determination in the applicant's favor which is final; or it must enter a determination adverse to the applicant, in which event it must prepare an SOR.

In a case in which the Screening Board's determination is adverse to the applicant, the applicant is informed thereof, is furnished a copy of the SOR, and is advised fully of the further procedures available to him. Those further procedures include the right to submit a written answer to the SOR; an opportunity for a hearing before an examiner; and, ultimately, a right of appeal to the Appeal Board. Should the applicant fail to submit a timely answer to the Statement of Reasons, he is denied clearance administratively, without further processing, and any existing clearance is revoked.

Hearing Examiner

Whenever an applicant replies to the SOR and elects not to request a hearing, the case is assigned to one of the field office examiners for determination based upon all available information, including the applicant's answer to SOR and any affidavits or factual information which the applicant may have furnished with it.

Whenever an applicant replies to the SOR and requests a hearing, a more involved procedure then comes into effect. The hearing is a most crucial stage of the adjudication of a security clearance case. The procedures incorporated in DOD Directive 5220.6 are an outgrowth of the Supreme Court decision in *Green* v. *McElroy* (1959), which held that, in the absence of explicit authorization from the President or Congress, DOD was not authorized to make a final denial or revocation of clearance by procedures which did not afford opportunity for confrontation and cross examination. The question of constitutional due process troubled the court very much, but by deciding the case on the issue of authority, the court postponed the constitutional question to another day. Nevertheless, the language of the court was very instructional. Accordingly, Executive Order 10865, dated Feb. 20, 1960, was issued to deal explicitly, among other things, with opportunity for cross examination. DOD Directive 5220.6, which was issued to implement the executive order, covers this matter in very specific detail and in a manner which assures due process.

Hearings are held before experienced hearing examiners who, to accommodate the applicants concerned, travel throughout the country. The Government is represented at each hearing by department counsel (trial counsel), who presents the government's case, cross-examines adverse witnesses, etc. The examiners and department counsel are qualified attorneys.

The applicant is entitled to be represented by counsel before the hearing examiner and, although it is not mandatory, most applicants do appear before the hearing examiner with legal counsel. The hearings are not subject to the Administrative Procedures Act, and strict rules of evidence are not applicable; however, the hearings in the security clearance program are conducted with much of the formality and professionalism of a court hearing, and rules of evidence normally followed in a court of law often are applied by the hearing examiners. One definite requirement which grew out of the Supreme Court's decision in the *Greene* case is that applicants must be afforded the opportunity to cross-examine their "accusers." The Defense Department may not, except as specified hereinafter, introduce a statement adverse to an applicant on a controverted issue unless the applicant is given the opportunity to cross-examine the person who furnished the adverse information. However, we are handicapped in this respect by not having the power of subpoena. Persons who have provided adverse information to investigators cannot be compelled to appear and testify at a hearing, and there have been cases in which they have refused.

The procedures set out in DOD Directive 5220.6, based upon the authority of Executive Order 10865, provide for two exceptions to the opportunity to cross-examine accusers, and only one of those exceptions actually has been invoked since issuance of the executive order in 1960. The first exception provides for the introduction of a certificate from the Attorney General to get into the hearing record adverse information furnished by a current confidential informant of the Federal Bureau of Investigation when, in the opinion of the Attorney General, it would be substantially harmful to the national interest to disclose the identity of the informant by bringing him forth as a witness. We have not yet found it necessary to utilize this exception.

The second exception permitting information or evidence to be received and considered by the hearing examiner without providing opportunity for cross-examination involves a situation in which the Assistant Secretary of Defense (Administration) personally certifies that the witness cannot appear at the hearing because of death, severe illness, or similar cause, or in which the Secretary of Defense determines that other "good and sufficient" cause exists for the witness not appearing. This latter exception has been used in only two cases.

There also is a saving clause in the DOD directive which permits the Secretary of Defense personally to order that the provisions of the directive, which require issuance of a Statement of Reasons, an administrative hearing, appeal, etc., shall be by-passed in a particular case whenever he determines personally that the provisions of the directive "cannot be invoked consistently with the national security." The latter extraordinary authority has never been exercised but is available should the need arise in a particular case. It might be invoked, at least theoretically, in a situation where for reasons of national security the

adverse information cannot be established at a hearing by a live witness or where for sound security reasons the Defense Department would not want to disclose the information which formed the basis for the action. This exception is designed to permit the Secretary of Defense to act summarily in a particular case which he personally has determined presents a very serious threat to the national interest, and in which the formal procedural requirements cannot reasonably be followed.

The hearing examiners make determinations which become final unless appealed within 10 days by either the applicant or department counsel.

The Appeal Board

The 3-man Appeal Board sits at the Pentagon, with the full-time duty of considering appeals either by applicants or by department counsel from determinations of examiners. All three members of this board are attorneys, and their deliberations are limited to the consideration of the case record created at the hearing level, together with briefs filed by the respective parties, and/or oral argument presented in formal sessions before the Appeal Board.

The Appeal Board's determinations are final, subject only to an appeal to the courts.

Department Counsel

The Chief Department Counsel and eight assistant department counsels are charged with representing the Defense Department before the hearing examiners and before the Appeal Board, and with assisting the Screening Board in cases pending before it. The five department counsels assigned to the field offices have the primary function of representing the Government at hearings before examiners. Those assigned to ISCRO headquarters in the Pentagon are charged primarily with reviewing cases prior to the issuance of SORs, preparing cases for hearing once answers to the SORs have been received, and representing the Government in cases before the Appeal Board.

The Office of Department Counsel also gives legal advice to the Deputy Assistant Secretary of Defense (Security Policy) and prepares litigation reports for submission to the Department of Justice whenever suit is filed against the Secretary of Defense, arising out of an industrial security clearance case.

As mentioned early in the article, the Defense Industrial Security Clearance Office (DISCO) is authorized to make final determinations favorable to applicants for security clearance; it is not authorized to make final adverse determinations. When DISCO cannot make a favorable determination under the standard, the case must be referred to the DOD Industrial Security Clearance Review Office (ISCRO) for adjudication.

Thousands of clearance applications are processed annually by DISCO without development of apparently substantial adverse information. Those applications are processed to final determination and clearances granted by DISCO without referral to ISCRO for adjudication. Of the 261,649 personnel security clearance applications processed by DISCO in FY 1969, only 944 (less than 0.4 percent of the total) required referral to ISCRO for adjudication in accordance with the procedures set out in DOD Directive 5220.6. Clearances were granted in the 99.6 percent of applications processed upon the basis of final determination by DISCO that it was clearly consistent with the national interest to do so.

DOD Reduces Barriers to Technology Transfer

Secretary of Defense Melvin R. Laird has taken new actions to accelerate achievement of DOD's objective to make more information available to the general public and the technical community, consistent with national security.

The first action taken was to see that only that defense technology which clearly needs to be protected in the national interest has a security classification, and that such security classifications be retained for the shortest possible time. In the past, major emphasis for classification had been placed only on the possible benefit of the information to potential enemies without any consideration towards the benefit it may give to the U.S. industrial and domestic community. Now, both reasons must be considered in making the classification decision.

DOD also has initiated a number of programs designed to declassify existing technological information which no longer needs to be classified. This will reduce or avoid costs within DOD and industry by eliminating a significant amount of security maintenance expenses. It also will make many previously classified technical reports available to the scientific, academic and technical community.

The final action is virtual elimination of the practice of limiting distribution of technical reports, whether classified or unclassified, to only selected segments of the Government, such as small project or special interest groups. Before this decision, at least 56 percent of the approximately 45,000 DOD technical documents prepared each year were withheld from the National Technical Information Service (NTIS), the primary outlet for DOD technical information to the public. At least 17 percent are withheld for security classification reasons, while some 39 percent are unclassified but withheld because the originator had placed a limitation on the report's distribution.

AIM-82 Cancelled

The Air Force has cancelled further efforts to develop the AIM–82 short range tactical air-to-air missile. Replacing it as the initial air-to-air missile for the F–15 air superiority fighter will be an advanced version of the Navy's AIM–9H Sidewinder. The advanced Sidewinder will also serve as an improved performance missile for current fighters.

The cancellation is the result of Air Force-Navy discussions on the development of a single missile for joint service and multiple aircraft use.

Progress in Controlling Management Systems

David H. Moran

So much criticism has been directed toward the Defense Department for acquisition management problems that we must take stock as to what corrective measures are being executed. The Defense Department has had a very comprehensive effort to control management systems underway since 1966. It has a number of built-in "fixes" for DOD acquisition management problems. The program is based on three steps:

- Collect all management systems used by DOD in a list useful for procurement and management people. Continually police the list, purging it of ineffective systems and eliminating redundancies.
- Control the development of new management systems and control the revision of existing management systems.
- Use effective criteria for selecting management systems for application on contract.

Progress

This joint government-industry project to restrain the proliferation of management systems was started as the result of efforts of both DOD and industry. The Assistant Secretary of Defense (Comptroller) expressed concern with this problem in a speech delivered March 3, 1966. Industry's concern was expressed in the Systems Management Analysis report, presented to the Defense Industry Advisory Council in June 1966. As a result of these and other events, *e.g.*, the publication of DOD Directive 7000.1, the Assistant Secretary of Defense (Comptroller) was charged with responsibility to discipline the generation and application of management systems. The Directorate for Management Systems Control, now a division, was established within the Office of the Assistant Secretary of Defense (Comptroller).

The accomplishments of the resulting Management Systems Control Program are tangible, effective tools, but the most difficult straits lie in the year ahead.

The accomplishments are:

- Publication of DOD Instruction (DODI) 7000.6, "The Development of Management Control Systems for Use in the Acquisition Process," in June 1968.
- Publication of DOD Instruction 7000.7, "The Selection and Application of Management Control Systems in the Acquisition Process," in June 1968.
- Compilation, publication and purging of the Management Control Systems List. The first interim edition was published in October 1968. The latest and authorized edition was published in July 1970. DOD Manual 7000.6M, the Authorized Management Control Systems List (AMCSL), is a list of approved management systems which conform to the standards for effective management systems found in DODI 7000.6. The AMCSL is, according to the Armed Services Procurement Regulation (ASPR), paragraph 1–331, the only valid source of management systems to levy on DOD contractors for contracts over $1 million. Special approval by the Service Secretaries is necessary for application of management systems not on the list.

With the publication of the AMCSL, a major milestone has been met in the program to control management systems.

Choosing a System

Let's discuss the problems of Service implementation, which fall squarely on the shoulders of the program managers and procurement people.

David H. Moran is Director, Management Systems Control, Office of the Assistant Secretary of Defense (Comptroller). His experience includes mechanical design, test engineering, production engineering, manufacturing, project management and management consulting. He was vice president and director of engineering, John I. Thompson and Co., Washington, D.C., before joining DOD. He holds a bachelor of science in engineering from University of California at Berkeley.

Of the two DOD instructions, DODI 7000.7, which is concerned with selection and application of management systems, has direct impact at the field level. DODI 7000.6 impacts at the command and headquarters level, because it is at those levels that most new management systems or revisions are generated.

Management systems are to be chosen from the AMCSL according to procedures laid down by ASPR. Emphasis is placed on the management plan. That is, the program manager designee must ask himself, "For prudent control over the resources to be expended, what management techniques or systems do I need? What do I need for management of expenditures and cost control? What do I need to manage and control schedule? What do I need to exercise control over technical performance?"

Obviously, the type of contract ultimately used has a bearing on the management systems to be used. Fixed price contracts by definition preclude or limit the need for reporting of costs. However, fixed price contracts are often opened up for changes. If this is suspected to occur, provision for unit cost control is in order from the outset.

Program managers, when made aware of the Management Systems Control Program, rightly ask, "What will it do for me?" The answer is, "Plenty!" This program represents a *revival* of good management practices. Past experience has shown that programs in trouble do not usually have a cohesive management plan. A search through the contract instrument of a program in trouble invariably discloses a disjointed approach to management. There is a clause here, a report requirement there, and a reference to an appendix farther on. In the past, there has been no single place in the contract instrument where the management system requirements were brought together to show a complete management picture.

A Management Control Systems Summary List (DD Form 1660) is now required as a part of the contract. This summary contains a list of management systems chosen from the AMCSL to implement the management plan, as well as statements regarding tailoring and specific contractor management systems acceptable in lieu of the authorized system.

DODI 7000.7 encourages the use of contractor systems acceptable to the criteria of DODI 7000.6. The authorized system called out on the DD Form 1660 is used as a model of specification where contractor systems are considered. Acceptable contractor systems are entered on the DD Form 1660 with the statement that they are accepted in lieu of the authorized system.

DODI 7000.7 encourages tailoring which utilizes only those portions of the management systems required for prudent resource stewardship. Additional requirements tacked on to approved systems are specifically forbidden without going through the approved rigors of the development instruction, DODI 7000.6, or without obtaining one-time approval from the Service Secretary.

The Management Systems Control Program was designed to dovetail with the consolidation of the several Service Authorized Data Lists. Cross references to management systems are provided in the Data Item Description (DD Form 1664). Also, this program naturally conforms with policy guidance from the Deputy Secretary of Defense to improve management and reporting to the Services.

Education of field level management and procurement personnel is the first priority at present. This is best accomplished by attacking specific problems encountered in management planning, as well as in writing both requests for proposal (RFP) and the contract instrument itself. The focus is on *more* and *better* management planning *prior* to committing the Defense Department to a contract.

Potential Benefit

The potential payoff of the Management Systems Control Program is big.

- There is emphasis on management planning as a requisite for choosing appropriate management systems from the AMCSL. Any lack of management planning shows up as a void or overlap on the Management Control Systems Summary List, DD Form 1660, in both the RFP and the contract. Reviewers of contract papers prior to signing can begin their check on adequacy by looking for appropriate schedule controls, cost controls and technical performance controls listed on the DD Form 1660.
- There is emphasis on tailoring specific management systems to fit the application. Again, the DD Form 1660 provides the reference to the page in the RFP or contract where specific provisions of the management system are tailored.
- There is emphasis on using effective contractor systems when they comply with the system called for on the DD Form 1660. In this, the AMCSL reference is used as a criterion to which the contractor system must conform satisfactorily. Again, the DD Form 1660 provides for the statement that a certain contractor system, properly identified, described and dated, is acceptable in lieu of a Government specified system.
- For the first time, data products (reports and forms) are required to be related to management systems from which they stem. This is done by a cross reference to the Contract Data Requirement List (DD Form 1423) and the related data product.

Conclusion

This program has a solid foundation and is just now being followed to the extent that its impact is being felt by managers and procurement people. The number of new management systems developed last year was minimal.

New major weapon buys now include DD Form 1660 in the RFPs and contracts. This brings management provisions into focus for those responsible to determine their adequacy, lacks, or potential dangers before contract signing.

The authorized list of management systems for use on contract numbers 170 systems. In addition, there are approximately 90 management systems unique to certain programs. These do not conform to the DODI 7000.6 standards for management systems but are used under a "grandfather clause" arrangement. When the programs using these unique systems phase out, so will the management systems.

A schedule for consolidation of the existing 170 management systems is being prepared. DOD expects to cut the number of approved management systems to about 50.

Status of ASPR Committee Cases

The following is a listing (revised as of Oct. 27, 1970) of the cases currently under consideration by the Armed Services Procurement Regulation (ASPR) Committee, of the Office of the Assistant Secretary of Defense (Installations and Logistics).

On items marked by asterisks, the text has been omitted to shorten the listing. The asterisks denote actions taken as shown below:

*—Case closed, no ASPR revisions resulting.

**—Case closed, approved for printing in a subsequent ASPR revision.

***—Case closed, approved for printing subject to further government coordination.

The listing includes subjects of interest to contractors but excludes cases of a minor or editorial nature, those considered "sensitive," and those involving a deviation from the regulation which are processed by the ASPR Committee.

The ASPR Committee meets with representatives of major industry associations periodically to explain the purpose and status of each of the cases under consideration, and to answer questions from industry representatives concerning the cases. All proposed ASPR changes of major policy are forwarded to industry associations in draft form for the review and comments of the association memberships. Industry comments are evaluated by the Defense Department before a final decision on the proposal is made by the ASPR Committee.

** ASPR Case No. 64-656—*Communications Services.*

** ASPR Case No. 67-24—*Advance Understandings of Allowability, ASPR 15-107.*

ASPR Case No. 68-14—*Revisions to ASPR 15-205, Cost Principles on Bid and Proposal and Independent Research and Development.* Previous action on this case has been overtaken by the enactment of Public Law 91-441. Action is now being taken to implement the new statute. It is contemplated that implementation of this law will initially be accomplished by the issuance of a Defense Procurement Circular (DPC) to cover the period through Dec. 31, 1970. Subsequent to the issuance of the DPC, action will be taken to issue revisions of the Independent Research and Development (ASPR 15-205.35) and the Bid and Proposal (ASPR 15-205.3) cost principles to provide permanent implementation of the statute.

ASPR Case No. 68-184—*Clauses for Service Contracts.* To develop a new part for ASPR Section VII to cover service contracts generally, incorporating by reference, to the extent feasible, the fixed-price and cost-reimbursement clauses contained in Parts 1 and 2 of Section VII. The material developed by the subcommittee under this case was forwarded to industry for comment on Sept. 3, 1970.

ASPR Case No. 68-214—*Proposed ASPR 9-203(f) Clause, Rights in Technical Data—For RDT&E and Acquisition Contracts for Major Systems and Subsystems.* To consider modifying the ASPR policy concerning rights in technical data insofar as research, development, test and evaluaton (RDT&E) and acquisition contracts for major systems and subsystems are concerned, by prescribing a special clause for inclusion in prime major systems and prime subsystems RDT&E contracts which would require the contractor to permit subcontractors to sell subcontractor fabricated parts or services directly to the Government without the payment of license fees or other inhibition of limited rights data furnished by the prime contractor. Industry and government comments have been received and are currently under study.

ASPR Case No. 67-89—*Delinquent Delivery Schedules on Other Than Cost-Reimbursement Type Supply and Service Contracts.* To modify various provisions of Section VIII, Part 6, to clarify the rights and obligations of both parties in the event of delinquent performance. The proposed revisions were forwarded to industry for comment on March 3, 1969. Industry comments have been received. This matter is still under consideration.

**ASPR Case No. 69-6—*"Termination—Determination Whether for Default or Convenience" Clause.* The committee approved certain changes to ASPR 7-105.3 "Stop Work Orders" to authorize conversion of a stop work order to a "Termination for Default" as well as a "Termination for Convenience." Consideration of the proposed clause "Termination—Deferring Determination Whether for Default or Convenience" was suspended indefinitely.

ASPR Case No. 69-12—*Conflict of Interest Clause.* To consider whether further guidance in the regulation and appropriate contractual safeguards should be provided to avoid conflicts of interest which may be occasioned by acquisitions and mergers involving systems engineering contracts. This item was forwarded to industry for comment on July 8, 1969. Comments have been received and are currently under study.

ASPR Case No. 69-24—*ASPR Section IX, Part 2.* To consider whether amendments to Section IX, Part 2, and other pertinent ASPR sections are necessary in view of the re-issued DOD Instruction 5010.12, dated Dec. 5, 1968, entitled "Management of Technical Data." Industry and government comments have been received and are currently under study.

ASPR Case No. 69-76—*Verification of Catalog or Market Price Exceptions Under Public Law 87-653.* To consider the recommendation of the General Accounting Office that ASPR be revised: (i) to require contractors to submit sales data of recent commercial sales for approximately similar quantities of the proposed purchase by the

Government, prior to acceptance by the Government of a catalog or market price; and (ii) to further provide that contracting officers be required to verify the sales data submitted by contractors. The proposed coverage and a new DD Form 633 were forwarded to industry for comment on Sept. 29, 1969. As a result of industry and government agency comments, revised coverage was prepared and resubmitted to industry and government agencies for comment on Sept. 23, 1970.

** ASPR Case No. 69–105—*Health and Safety Clauses.*

ASPR Case No. 69–22—*Revision of ASPR B–311, C–311 and S3–603.* To make necessary revisions to Appendix B–311 and Appendix C–311 and Supplement 3 to provide for uniform reporting by contractors of government property. Revisions to DD Form 1662 are included in the case. Comments have been received and are under consideration.

ASPR Case No. 67–316—*Single-Service Management of Industrial Facilities.* To develop procedures which will provide that only one contract authorizing use of government facilities will be in effect at any one location. It is intended that contracts which authorize the acquisition or furnishing of government facilities will provide for the automatic transfer of those facilities to the "use" contract upon receipt of installation. This matter is still under consideration.

**ASPR Case No. 68–315—*Corporate Administrative Contracting Officer Program.*

* ASPR Case No. 69–114—*Bailment of Government Property to Contractors.*

ASPR Case No. 68–2—*ASPR 15–205.6(f), Deferred Compensation.* To clarify ASPR 15–205.6(f) covering deferred compensation in light of the questions raised concerning: (i) whether deductibility for Federal income tax purposes is a prerequisite to allowability for contract cost purposes; (ii) the extent to which acturial gains and losses (including unrealized market appreciation and depreciation) must be taken into account in determining costs; (iii) whether the cost of improvements in benefits to retired employees are allowable; (iv) whether pay-as-you-go pension payments are allowable; and (v) whether contributions of interest equivalents or unfunded pension liabilities are allowable. This item was forwarded to industry for comment on July 8, 1969. Industry and government agency comments have been received and considered. This matter is now being considered by higher authority as a matter involving major policy.

**ASPR Case No. 68–278—*ASPR Coverage for Training and Educational Costs.*

** ASPR Case No. 69–67—*Forward Pricing Rate Agreements.*

** ASPR Case No. 69–117—*Clarification of Application of CWAS to Limitations Contained in the Cost Principles.*

ASPR Case 69–131—*Warranties—Consequential Damages.* To develop DOD policy and appropriate ASPR coverage for contractual warranties expressed and implied relating to latent and patent defects, as well as consequential damages. This assignment involves not only consideration of the expressed or implied warranties under the "Inspection" clause, but further includes consideration of whether specific contractual provisions should be developed to cover these areas. Material developed under this case was sent to industry and other government agencies for comment on Oct. 19, 1970.

** ASPR Case No. 69–157—*Severance Pay to Employees on Support Service Contracts.*

ASPR Case No. 68–104—*Late Proposals and Modification in Negotiated Procurements.* To consider revising ASPR 3–506 covering late proposals and modification thereof in negotiated procurements in light of the numerous General Accounting Office (GAO) decisions in this area. This matter is now being considered by higher authority as a matter involving major policy.

ASPR Case No. 68–25—*Omnibus General Accounting Office (GAO) and DOD Audit Clauses.* To consider the feasibility of developing an omnibus GAO Examination of Records clause and an omnibus DOD Audit clause to replace the existing Examination of Records clauses and the numerous DOD Audit clauses. The development of a single Examination of Records clause has been undertaken in conjunction with representatives of the GAO. Similarly, a draft of a proposed single DOD Audit clause has been developed. Industry and government agency comments have been received and are under consideration.

ASPR Case No. 69–161—*Evaluation Criteria.* To undertake the development of additional guidance of evaluation criteria to be included in solicitations, thus giving effect to numerous General Accounting Office (GAO) decisions that prospective offerors should be advised of the relative importance to be attached to each evaluation factor. This matter is still under study.

ASPR Case No. 69–173—*Revision of Billing Prices Under Incentive Contracts and Price Redetermination Contracts.* To review the ASPR 7–108 Incentive Price Revision and the 7–109 Price Redetermination clauses and to recommend changes therein to permit upward adjustment of billing prices to conform to the policy in ASPR 3–404(a)(4). The military services have been authorized to deviate from the restrictions of the clauses pending the issuance of revised clauses which are currently being developed. The revised clauses and the clarification of 3–404 were forwarded to industry and government agencies for comment on Oct. 12, 1970.

ASPR Case No. 69–192—*Pricing of Indefinite Delivery Type Contracts.* To consider revising ASPR 3–409 to modify the restriction that indefinite delivery type contracts must provide for: (i) firm fixed prices, (ii) price escalation, or (iii) price redetermination, by allowing pricing on the basis of common manufacturers' price lists or industry pricing guides. This matter is presently under study.

ASPR Case No. 69–197—*Contractor Procurement System Review (CPSR).* To consider expanding existing ASPR coverage on CPSRs and consent to subcontract provisions to provide more detailed guidance. A report on this subject currently is being considered.

ASPR Case No. 69–249—*Time Extensions.* To consider the inclusion of a Time Extensions clause in construction contracts in which liquidated damages are included. A clause clarifying the existing rights of the Government, under the clauses set forth in ASPR 7–602.5 "Termination for Default—Damages for Delay—Time Extensions" and ASPR 7–602.3 "Changes" (February 1968 version), to extend the time for completion of work when a contractor is delayed by any of certain enumerated excusable delays. Industry comments have been received and are under consideration.

** ASPR Case No. 70–14—*Proposed Revision of ASPR Appendix I.*

ASPR Case No. 70–19—*Wage and Material Price Escalation.* To review existing ASPR escalation provisions to determine the advisability of developing additional wage and material price escalation clauses for use in contracts for complex weapon systems to be produced over an extended period of time. Clauses developed by a Special Study Group established to review this subject, were forwarded to industry for comment on May 18, 1970.

ASPR Case No. 70–38—*Proposed Change to ASPR 15–205.16, Insurance and Indemnification.* To consider a suggestion that ASPR 15–205.16 be revised to specifically limit allowable costs of self-insurance for future liabilities to an amount determined on a present value basis. Material developed under this case was sent to industry and other government agencies for comment Aug. 3, 1970.

ASPR Case No. 70–39—*Allocation of Contractors' Cost for Special Facilities.* To consider additions or revisions to Section XV to clarify cost allocation procedures under ASPR 15–201.4 in general, and allocation of the costs of special facilities such as wind tunnels, in particular. Material developed under this case was sent to industry and other government agencies for comment on Sept. 3, 1970.

ASPR Case No. 70–41—*Capital Data Employed.* To consider the advisability of initiating a policy change to use capital-employed as a factor in developing pre-negotiation profit objectives. This matter has been assigned to a specially selected subcommittee and currently is under study. Worksheets developed by the subcommittee to obtain the necessary data to test the concept were submitted to industry and other government agencies for comment on Oct. 9, 1970.

ASPR Case No. 68–69—*Proposed Addition—Special Tooling Retention/Storage Agreements.* To consider the development of guidance and a standard contract format for use when special tooling or special test equipment is to be stored at the contractor's facility for use on subsequent production contracts. Proposed coverage was forwarded to industry for comment on April 10, 1970. Comments have been received and are currently under study.

ASPR Case No. 70–55—*Clarification on Computed Bond Requirements.* To provide guidance on the amount of bond requirements for requirement-type construction contracts. This matter currently is under study.

ASPR Case No. 70–59—*ASPR 15–205.34—Rental Costs.* To correct a misconception of the intent of ASPR 15–205.34 by substituting the word "property" for "facilities and equipment." Industry and other government agencies comments on the proposed revision have been received and are under consideration.

ASPR Case No. 70–62—*Proposed Changes to Milk Price Adjustment Clause in ASPR 7–1301.8 and 7–1301.9.* To resolve the difficulties being encountered in establishing reasonable prices for milk products under the present ASPR clauses by substituting a cancellation provision. The proposed coverage was submitted to appropriate industry associations and the General Accounting Office for comment on Aug. 10, 1970.

ASPR Case No. 70–64—*Personnel Management Review Including Executive Compensation.* To consider the advisability of adopting on a DOD-wide basis a procedure developed by Defense Supply Agency to review a contractor's compensation structure in order to determine if it will produce reasonable costs under government contracts. This matter has been assigned to a subcommittee and is currently being studied.

ASPR Case No. 70–67—*Revision of ASPR—Termination of Use Notices.* To consider amending the clauses set forth in ASPR 7–702.23 and 7–702.24 concerning contractor written notice of termination of use of additional facilities, by incorporating a 10-day idle reporting time. This matter has been assigned to a subcommittee and currently is under study.

ASPR Case No. 70–78—*Duty-Free Entry Clause Notices.* To revise the procedures resulting from clauses set forth in ASPR 6–603 and 6–605 by requiring the contractor to notify the contract administration office of imported supplies only when an actual award is made to a foreign supplier; and by eliminating the requirement that a foreign supplier forward a copy of the bill of lading to a designated government representative. Copies of the revised ASPR coverage on this matter were forwarded to industry and other government agencies for comment on Sept. 4, 1970.

ASPR Case No. 70–83—*Rights in Data—Computer Programs.* To consider the desirability of developing a standard ASPR Special Rights in Data clause for computer systems analyses and programming services. This matter was assigned to a subcommittee and currently is under study.

ASPR Case No. 70–90—*Interpretation of ASPR 11–401.1, Tax Clause.* To determine whether social security taxes should be subject to the adjustment procedures of the 11–401.1 Tax clause. This matter was assigned to a subcommittee and currently is under study.

ASPR Case No. 70–103—*Control of Constructive Changes and Other Claims on Nonconstruction Contract.* To consider the need for clauses in ASPR similar to those in Navy Procurement Circular (NPC) No. 15 to control the constructive changes problem. The committee authorized the Navy to continue its test of the clauses in NPC No. 15 until June 30, 1971. Other military services may use the NPC No. 15 clauses on a case-by-case basis after committee concurrence. With regard to a related Army clause, Preproduction Evaluation, the committee determined

that the Army has the right to use the clause when appropriate. The overall problem of controlling constructive changes was assigned to a subcommittee and currently is being studied.

ASPR Case No. 70–108—*Proposed Revision to ASPR Relating to Policy Guidance on Major Weapon System Acquisition.* To consider the impact on ASPR of Deputy Secretary of Defense Packard's policy memorandum of May 28, 1970. This matter was assigned to a subcommittee and currently is under study. The subcommittee's assignment primarily involves Section III, Part 4, "Types of Contracts," and Section IV, Part 1, "Procurement of Research and Development." In a related case, the ASPR Committee has approved deletion of ASPR 1–330, "Total Package Procurement" as a result of Mr. Packard's memorandum.

ASPR Case No. 70–113—*ASPR 15–204, Application of Principles and Procedures.* To clarify the intent that Section XV be used in the pricing of fixed-price subcontracts whenever the prime contract is subject to Section XV and that fixed-price subcontracts thereunder are subject to cost analysis, price revision, or price redetermination. The proposed coverage on this matter was submitted to industry and other government agencies for comment on Sept. 9, 1970.

ASPR No. 68–174—*Jewel Bearings, ASPR 1–315.* Defense interests require the continued maintenance of an active and versatile mobilization base for the domestic production of jewel bearings and related items. Procurement of jewel bearings by the Government and government contractors under the guidance in the present ASPR 1–315 has not been sufficient to carry out policy ob-objectives in this area. The policy remains unchanged but the coverage is more detailed and explicit. The proposed coverage also contains a new provision relating to standardization requiring that redesign of military items provide for the use of military standard jewel bearings. Industry and other government agency comments have been received and currently are under study.

Naval Ordnance Lab

(*Continued from page 12.*)

touch with industry as it affects the project.

The development of Subroc, the Navy's underwater-to-air-to-underwater missile, is an excellent example of NOL's partnership with industry. Subroc, a missile launched underwater to travel through the air to return to water to seek its target, was a bold, new weapon conceived at NOL. The idea was further developed by contract, with Goodyear Aerospace Corp. the prime contractor, and with NOL providing technical direction. Together they solved many knotty problems of design and construction, and brought the revolutionary idea from the drawing board to production.

It is always of interest to speculate on the future, although this is even more uncertain than usual this year.

The general reduction in defense expenditures and the rising cost of an engineering manyear will surely mean that new starts of major systems will be even more seriously scrutinized. We will have to be more adroit in applying the principles of good old American ingenuity toward making equipment that does the job at lower cost. There must be simpler ways to do things that are not quite so automatic, or comprehensive, or flexible. More attention must be given to simplicity in maintenance and lucidity in design. Paradoxically, the key to achieving this goal is true technical competence and a first hand knowledge of the operating environment. These things are acquired, among other ways, by the expenditure of research and development effort. We will have to exercise more restraint in going into production while still spending money on design and test.

The recently reaffirmed policy of "try before buy" will call for increased cooperation between potential industry producers and government laboratories, charged with the task of determining that a development really does perform as it is supposed to before the Government commits decreasing resources to large-scale production.

SUPERSONIC INLET design model is mounted in a 4-foot transonic tunnel at the Arnold Engineering Development Center, Arnold AFS, Tenn., by Stan Ton, left, of the Northrop Corp., and Bobby Moreland, ARO, Inc., contract operator of the center. Performance of air inlets for supersonic jet aircraft may be determined in high-speed tunnels without having to actually fly the aircraft. By altering tunnel pressure and Mach number, most of the conditions of altitude, speed and attitude the aircraft will encounter in actual flight can be simulated to determine the inlet's performance. The Air Force Systems Command's Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, is sponsoring tests directed toward development of propulsion systems for future applications.

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

Vernon McKenzie has been named as Special Asst. to the Asst. Secretary of Defense (Health and Environment).

C. **Stuart Broad** has been designated Dir. for Equal Opportunity (Civilian) in the Office of the Dep. Asst. Secretary of Defense (Equal Opportunity), Office of the Asst. Secretary of Defense (Manpower and Reserve Affairs).

Dr. Robert Langelier has been named Staff Specialist for Sattelite Communications Systems, Office of the Asst. to the Secretary of Defense (Telecommunications).

New assignments in the Advanced Research Projects Agency are: **Dr. Eric H. Willis**, Dir., Nuclear Monitoring Research; and **Dr. Maurice J. Sinnott**, Dir., Materials Sciences.

Capt. Jacob W. Updegrove, CEC, USN, has replaced **Col. Jean E. Crabtree, USAF**, as Staff Dir. for Installations and Services, Hq. Defense Supply Agency. Col. Crabtree retired.

Capt. William A. Johannesen, SC, USN, has been assigned as Executive Director, Contract Administration Services (CAS), Hq. Defense Supply Agency.

Col. Forrest R. Dupont, USAF, is the new Commander, Defense Contract Administration Services, St. Louis Region, St. Louis, Mo.

DEPARTMENT OF THE ARMY

Gen. (selectee) Henry A. Miley, Jr. is the new Commanding General, Army Materiel Command. He replaces **Gen. Ferdinand J. Chesarek**, who has retired.

Lt. Gen. (selectee) Woodrow W. Vaughan, replaces Gen. Miley as Dep. Commanding General, Army Materiel Command.

Lt. Gen. George I. Forsythe has been assigned as Project Manager, All-volunteer Army, an effort designed to end the draft by mid-1973. In his new position, Gen. Forsythe will report directly to Secretary of the Army **Stanley R. Resor** and **Gen. W. C. Westmoreland, Army Chief of Staff**. Gen. Forsythe was formerly Commanding General of the Army Combat Developments Command.

The new Commanding General, U. S. Army Combat Developments Comand, Fort Belvoir, Va., is **Lt. Gen. (selectee) John Norton**. Gen. Norton served previously as Dep. Project Manager, Project Mobile Army Sensor Systems Test Evaluation and Review (MASSTER), Fort Hood, Tex. **Major General George P. Seneff Jr.** is the new Project Manager of MASSTER.

Lt. Gen. (selectee) Robert R. Williams, formerly Dep. Asst. Chief of Staff for Force Development has been named Asst. Chief of Staff for Force Development, Hq., U.S. Army. He will replace **Lt. Gen. Frederick C. Weyand.**

Col. Sam H. Sharp has been named Dep. Chief of Staff for the Army Strategic Communications Command, Fort Huachuca, Ariz. Col. Sharp succeeds **Col. Emil V. B. Edmond** who was retired.

Lt. Col. Calvin A. Storment has been named Commanding Officer of the East Coast Telecommunications Center, Fort Detrick, Md.

Lt. Col. Albert M. Desselle, USMC, became the first Marine Corps liaison officer to join the Army Computer Systems Command headquarters staff, Fort Belvoir, Va.

DEPARTMENT OF THE NAVY

Adm. Jackson D. Arnold, who has been performing the duties of Chief of Naval Material and Commander, Naval Material Command since the retirement of **Adm. I. J. Galantin**, has been elevated to the rank of admiral and position of Chief of Naval Material. He is the first aeronautical engineering duty officer to attain the rank of admiral.

Vice Adm. (selectee) George E. Moore II, SC, relieves Adm. Arnold as the Vice Chief of Naval Material. Admiral Moore is the only Navy Supply Corps officer serving in the rank of vice admiral.

Gen. (selectee) Keith B. McCutcheon, USMC, will be the new Asst. Commandant of the Marine Corps. He replaces **Gen. Lewis Walt**, who will retire Feb. 1, 1971.

Lt. Gen. (selectee) Donn J. Robertson, USMC will relieve Gen. McCutcheon as Commanding General of the III Marine Amphibious Force.

In Hq., U.S. Marine Corps, **Lt. Gen. John R. Chaisson, USMC**, will become Chief of Staff. He succeeds **Lt. Gen. William J. Van Ryzin, USMC**, who will retire on May 1, 1971. **Lt. Gen. (selectee) Hugh M. Elwood, USMC**, will replace Gen. Chaisson as Dep. Chief of Staff (Plans, and Programs).

Rear Adm. William R. McClendon has been assigned as Dir., Aviation Plans Div., Office of the Chief of Naval Operations.

Rear Adm. W. J. Moran is the new Commander, Naval Weapons Center, China Lake, Calif. **Capt. Melvin R. Etheridge**, former Commander, has retired.

Capt. Norman D. Chetlin will be the new commanding officer of the Fleet Material Support Office, Mechanicsburg, Pa. He will replace Capt. **Donald A. Hempson**, who will retire Jan. 1. Capt. **Richard D. Johnson** will succeed Capt. Chetlin as the Fleet Material Support Office Executive Officer.

DEPARTMENT OF THE AIR FORCE

Brig. Gen. William H. Best Jr. is now Commander, Air Weather Service, Scott AFB, Ill., which is also the global environment-support agency for the Army. Col. **Thomas A. Aldrich** is the new Vice Commander of the Air Weather Service.

Col. John G. Dailey, Commander of the Air Force Human Resources Laboratory, Brooks AFB, Tex., has retired.

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Status of Funds Quarterly Report

Outlays

Fourth Quarter, Fiscal Year 1970

(Thousands of Dollars)

Department of Defense	Outlays				Unpaid obligations	
	Apr 1970	May 1970	Jun 1970	Cum thru 30 Jun 1970	At start of year	As of 30 Jun 1970
Military Personnel						
Active forces	1,941,678	1,936,655	2,100,633	21,976,604	592,306	392,282
Reserve forces	77,039	79,697	136,214	1,054,136	152,294	216,256
Undistributed	103,174	−54,833	64,174	—	—	—
Total—Military Personnel	2,121,891	1,961,518	2,301,022	23,030,740	744,601	608,538
Retired Military Personnel						
Retired Pay, Defense	248,058	249,418	250,981	2,849,262	6,354	9,799
Operation and Maintenance	1,816,185	1,800,534	1,929,664	21,608,922	3,924,991	3,871,232
Procurement						
Aircraft	682,495	634,634	661,122	7,926,435	7,701,062	5,776,572
Missiles	249,589	261,514	306,213	2,912,309	2,516,998	2,686,931
Ships	176,630	184,138	109,958	2,065,660	3,085,253	2,956,147
Tracked combat vehicles	31,958	30,712	38,660	320,977	454,414	339,517
Ordnance, vehicles and related equipment	449,129	426,096	590,466	5,266,690	5,690,581	4,030,014
Electronics and communications	95,992	62,753	163,729	1,174,306	1,621,409	1,469,164
Other procurement	147,657	107,265	163,155	1,839,864	2,016,381	2,083,572
Undistributed	−29,136	−19,891	−400,550	77,488	128,925	48,695
Total—Procurement	1,804,313	1,687,221	1,632,753	21,583,728	23,215,023	19,390,614
Research, Development, Test, & Evaluation						
Military sciences	73,320	76,244	112,548	948,078	712,919	668,097
Aircraft	94,312	128,211	111,929	1,238,830	681,935	805,367
Missiles	181,879	153,649	202,086	2,196,279	1,077,605	1,005,599
Astronautics	59,217	38,951	58,387	752,550	452,428	405,903
Ships	35,794	26,945	32,488	362,393	284,836	228,517
Ordnance, vehicles and related equipment	25,236	22,670	30,011	320,938	229,411	167,915
Other equipment	75,317	69,535	59,069	882,779	501,780	478,261
Program-wide management & support	37,584	40,695	36,389	462,254	282,019	203,550
Undistributed	2,788	−15,903	−25,459	2,176	38,151	21,673
Total—Research, Development, Test, and Evaluation	585,444	540,998	617,448	7,166,277	4,261,084	3,984,882
Military Construction	80,087	75,824	98,221	1,168,142	1,806,093	1,656,056
Family Housing	49,617	47,765	51,683	613,600	256,946	201,617
Civil Defense	5,940	6,652	7,464	80,084	55,255	43,569
Other—Special Foreign Currency Program	84	67	135	884	363	1,239
Revolving and Management Funds	−169,287	−176,009	−242,388	−807,073	6,615,240	5,406,532
Applicable receipts	−11,900	−6,542	−8,847	−135,194	—	—
Subtotal—Federal Funds	6,530,432	6,187,449	6,638,133	77,159,372	40,885,950	35,174,076
Trust Funds	926	−426	−1,338	2,287	4,821	4,449
Interfund Transactions	−1	−2,148	5	−6,806	—	—
Total—Military Functions	6,531,356	6,184,875	6,636,801	77,154,853	40,890,771	35,178,526
Military Assistance						
Federal Funds	47,532	71,183	50,807	593,215	1,562,839	1,180,972
Trust Funds	24,748	67,072	4,656	137,581	227,015	197,209
Total—Military Assistance	72,279	138,256	55,463	730,796	1,789,854	1,378,182
TOTAL—DEPARTMENT OF DEFENSE	6,603,634	6,323,131	6,692,264	77,885,649	42,680,624	36,556,707

Department of the Army

Military Personnel						
Active forces	773,851	803,130	933,267	9,017,713	213,798	48,731
Reserve forces	47,073	47,455	93,199	683,249	115,658	169,552
Undistributed	101,684	−53,796	76,295	—	—	—
Total—Military Personnel	922,607	796,791	1,102,759	9,700,961	329,457	218,283
Operation and Maintenance	694,205	649,667	781,314	7,879,151	1,337,348	1,299,217
Procurement						
Aircraft	56,322	76,174	72,147	836,916	1,063,782	688,916
Missiles	55,582	74,555	123,144	743,449	848,404	788,041
Tracked combat vehicles	28,795	30,284	36,103	302,174	431,068	313,832
Ordnance, vehicles and related equipment	240,478	197,484	275,700	2,454,960	2,965,280	2,067,170
Electronics and communications	−4,423	−3,755	90,335	342,594	581,475	440,476
Other procurement	59,906	31,899	89,738	494,287	682,896	835,266
Undistributed	−37,245	−18,645	−396,284	31,741	39,722	15,419
Total—Procurement	399,415	387,996	290,883	5,206,121	6,612,627	5,149,121
Research, Development, Test, and Evaluation						
Military sciences	12,028	8,687	35,655	161,335	96,888	88,015
Aircraft	10,442	7,746	8,280	86,761	89,782	81,045
Missiles	77,468	57,800	107,661	849,879	419,831	385,107
Astronautics	859	553	350	7,444	3,813	8,674
Ordnance, vehicles and related equipment	13,963	12,511	14,900	169,131	115,667	100,453
Other equipment	28,185	30,330	14,075	333,197	196,095	173,811
Program-wide management and support	3,496	3,863	4,486	53,970	32,104	29,835
Undistributed	−1,995	−5,023	−21,753	3,760	13,651	8,495
Total—Research, Development, Test, and Evaluation	144,446	116,467	163,654	1,665,477	967,831	875,435
Military Construction	47,937	23,768	41,143	457,834	776,104	889,562
Revolving and Management Funds	−35,585	−69,783	−55,078	−113,314	1,856,891	1,368,276
Applicable Receipts	−5,004	−3,001	−3,578	−70,833	—	—
Subtotal—Federal Funds	2,168,022	1,901,903	2,321,098	24,725,397	11,880,257	9,799,893
Trust Funds	960	−1,274	−1,649	−624	89	3
TOTAL—DEPARTMENT OF THE ARMY	2,168,982	1,900,630	2,319,447	24,724,772	11,880,346	9,799,895

Department of the Navy

	Outlays				Unpaid obligations	
	Apr 1970	May 1970	Jun 1970	Cum thru 30 Jun 1970	At start of year	As of 30 Jun 1970
Military Personnel						
Active forces	654,872	532,370	614,044	6,489,547	168,734	174,773
Reserve forces	14,771	15,388	21,725	181,480	23,320	30,806
Undistributed	10,634	−4,122	−13,586	—	—	—
Total—Military Personnel	680,279	543,636	622,181	6,671,026	192,054	205,579
Operation and Maintenance	456,649	443,925	432,626	5,552,548	1,537,613	1,650,454
Procurement						
Aircraft	218,886	210,775	228,129	2,466,909	2,861,615	2,190,060
Missiles	64,702	65,218	74,061	701,655	703,716	789,424
Sbips	176,630	184,138	109,958	2,065,660	3,085,253	2,956,147
Tracked combat vehicles	3,163	428	2,557	18,803	23,346	25,685
Ordnance, vehicles and related equipment	88,717	117,097	137,896	1,398,755	1,536,287	1,122,482
Electronics and communications	28,939	29,822	38,155	416,816	576,715	532,523
Other procurement	49,378	27,904	58,870	843,293	1,194,841	1,083,515
Undistributed	1,178	−1,055	−435	32,658	71,369	28,264
Total—Procurement	631,593	634,327	649,191	7,944,549	10,053,142	8,728,100
Research, Development, Test, and Evaluation						
Military sciences	11,357	12,935	17,302	164,912	129,992	101,989
Aircraft	55,761	71,931	72,561	594,422	253,929	421,194
Missiles	37,598	36,280	35,607	490,974	291,240	253,019
Astronautic	2,378	2,561	3,220	21,788	15,598	12,834
Ships	35,794	26,945	32,488	362,393	284,836	228,517
Ordnance, vehicles and related equipment	11,273	10,159	15,111	151,807	113,744	67,462
Other equipment	20,217	17,622	22,575	196,434	77,139	119,732
Program-wide management and support	12,036	8,652	7,928	105,826	219,464	127,399
Undistributed	−263	−4,943	−1,996	−4,308	14,446	7,588
Total—Research, Development, Test, and Evaluation	186,151	182,142	204,796	2,084,248	1,400,388	1,339,735
Military Construction	12,547	24,653	33,109	333,272	616,207	567,294
Revolving and Management Funds	−78,973	−7,503	28,374	−45,134	2,199,935	2,007,542
Applicable receipts	−3,503	−2,216	−3,024	−38,606	—	—
Subtotal—Federal Funds	1,884,742	1,818,965	1,967,254	22,501,904	15,999,338	14,498,705
Trust Funds	880	362	601	6,531	277	479
Interfund Transactions	−1	−2,148	5	−6,806	—	—
TOTAL—DEPARTMENT OF THE NAVY	**1,885,620**	**1,817,178**	**1,967,860**	**22,501,628**	**15,999,615**	**14,499,184**

Department of the Air Force

Military Personnel,						
Active forces	512,956	601,154	553,323	6,469,344	209,774	168,779
Reserve forces	15,195	16,854	21,291	189,408	13,316	15,898
Undistributed	−9,146	3,085	1,466	—	—	—
Total—Military Personnel	519,006	621,092	576,080	6,658,752	223,090	184,676
Operation and Maintenance	567,251	596,896	595,713	6,995,222	953,240	805,617
Procurement						
Aircraft	407,287	347,685	360,846	4,622,610	3,775,665	2,897,596
Missiles	129,305	121,741	109,008	1,467,205	964,878	1,109,466
Ordnance, vehicles and related equipment	119,909	111,485	176,848	1,412,290	1,188,875	840,334
Electronics and communications	70,492	36,547	34,631	408,439	455,843	490,567
Other procurement	34,242	46,349	12,353	438,518	95,195	101,127
Undistributed	6,936	−146	−3,872	13,089	17,834	5,012
Total—Procurement	768,170	663,661	689,815	8,362,151	6,498,290	5,444,102
Research, Development, Test, and Evaluation						
Military sciences	11,064	14,423	10,584	142,416	90,842	86,221
Aircraft	28,109	48,534	31,088	557,647	338,224	303,128
Missiles	66,813	59,569	58,818	855,426	366,534	367,473
Astronautics	55,980	35,837	54,817	723,318	433,017	384,395
Other equipment	26,915	21,583	22,419	353,148	228,546	184,718
Programwiide management and support	22,052	28,180	23,975	302,458	30,451	46,316
Undistributed	5,046	−5,937	−1,710	2,724	10,054	5,590
Total—Research, Development, Test, and Evaluation	215,976	202,191	199,990	2,937,137	1,497,668	1,377,840
Military Construction	18,785	26,738	22,906	365,760	393,810	183,507
Revolving and Management Funds	−25,841	−55,515	−75,058	−422,569	1,276,941	—
Applicable Receipts	−3,388	−1,321	−2,221	−25,704	—	1,139,994
Subtotal—Federal Funds	2,059,957	2,053,744	2,007,224	24,870,749	10,843,039	9,135,736
Trust Funds	−916	486	−287	−3,619	4,323	3,967
TOTAL—DEPARTMENT OF THE AIR FORCE	**2,059,040**	**2,054,230**	**2,006,936**	**24,867,129**	**10,847,362**	**9,139,703**

Defense Agencies/Office of the Secretary of Defense	Outlays				Unpaid obligations	
	Apr 1970	May 1970	Jun 1970	Cum thru 30 Jun 1970	At start of year	As of 30 Jun 1970
Operation and Maintenance	94,516	107,105	115,367	1,139,851	93,268	111,547
Procurement						
Ordnance, vehicles and related equipment	25	30	22	685	139	28
Electronics and communications	984	139	608	6,457	7,376	5,598
Other procurement	4,131	1,113	2,194	63,766	43,449	63,664
Undistributed	−5	−45	41	—	—	—
Total—Procurement	5,135	1,237	2,864	70,907	50,964	69,291
Research, Development, Test and Evaluation						
Military sciences	38,871	40,199	49,007	479,415	395,197	391,872
Military Construction	820	665	1,063	11,277	19,972	15,693
Revolving and Management Funds	−28,887	−43,209	−140,626	−226,056	1,281,474	890,720
Applicable receipts	−6	−4	−24	−51	—	—
Subtotal—Federal funds	110,449	105,993	27,652	1,475,343	1,840,875	1,479,123
Trust funds	—	—	—	—	—	—
TOTAL—DEFENSE AGENCIES/OSD	110,449	105,993	27,652	1,475,343	1,840,875	1,479,123
Defense-Wide						
Military Retired Personnel	248,658	249,418	250,981	2,849,262	6,354	9,799
Operation and Maintenance	3,564	2,941	4,643	42,149	3,523	4,396
Family Housing	49,617	47,765	51,683	613,600	256,946	201,617
Other Special Foreign Currency Program	84	67	135	884	363	1,239
TOTAL—DEFENSE-WIDE	301,324	300,191	307,442	3,505,896	267,186	217,051
Office of Civil Defense						
Civil Defense	5,940	6,652	7,464	80,084	55,255	43,569

Obligations

Department of Defense	Available for obligation	Obligations			Cum thru 30 Jun 1970	Unobligated balance 30 Jun 1970
		Apr 1970	May 1970	Jun 1970		
Military Personnel						
Active forces	22,074,300	1,959,940	1,972,790	1,794,694	22,070,935	3,365
Reserve forces	1,147,511	101,784	106,644	157,001	1,134,416	13,094
Total—Military Personnel	23,221,811	2,061,724	2,079,433	1,951,696	23,205,351	16,460
Retired Military Personnel						
Retired Pay, Defense	2,858,000	248,568	249,938	251,297	2,853,234	4,766
Operation and Maintenance	23,977,090	2,061,658	1,680,782	2,645,465	23,902,115	74,975
Procurement						
Aircraft	9,912,845	457,195	613,472	1,348,631	6,437,658	3,475,187
Missiles	4,097,303	211,598	135,804	527,686	3,156,319	940,984
Ships	4,485,249	68,898	71,591	351,984	2,034,402	2,450,847
Tracked combat vehicles and other weapons	370,444	14,410	11,122	62,055	288,839	81,605
Ordnance, vehicles and related equipment	6,712,426	335,915	191,107	514,644	5,146,445	1,565,981
Electronics and communications	2,194,895	94,385	58,146	261,229	1,184,776	1,010,119
Other procurement	2,986,293	149,187	151,709	395,518	2,263,673	722,620
Undistributed	418,923	−778	−767	3,051	−231	419,154
Total—Procurement	31,178,378	1,330,814	1,232,188	3,464,797	20,511,882	10,666,496
Research, Development, Test, and Evaluation						
Military sciences	1,090,285	73,436	70,915	174,423	956,890	133,395
Aircraft	1,671,266	78,841	35,439	151,688	1,372,214	299,052
Missiles	2,496,822	97,342	75,128	224,404	2,287,446	209,376
Astronautics	879,156	49,691	34,902	98,650	781,505	97,651
Ships	360,568	11,015	13,490	18,190	314,202	46,366
Ordnance, vehicles, and related equipment	339,511	17,672	13,291	40,238	268,438	71,073
Other equipment	1,196,697	60,693	49,767	119,061	905,090	291,607
Program-wide management and support	666,317	42,496	46,952	68,279	593,317	73,000
Emergency fund	—	—	—	—	—	—
Undistributed	−494	−313	−465	553	−3,529	3,035
Total—Research, Development, Test and Evaluation	8,700,128	430,873	339,420	895,485	7,475,572	1,224,555
Military Construction	3,018,081	94,453	121,540	288,300	1,536,954	1,481,127
Family Housing	690,163	64,856	44,803	82,582	576,877	113,286
Civil Defense	75,205	4,323	2,946	7,814	69,708	5,496
Other—Special Foreign Currency	15,162	329	330	359	1,760	13,401
Revolving and Management Funds	21,565,971	1,608,131	1,486,771	1,640,244	20,386,697	1,179,273
Offsetting receipts	−135,194	−11,797	−6,468	−9,054	−135,194	—
Subtotal—Federal funds	115,164,793	7,893,933	7,231,682	11,218,986	100,384,957	14,779,836
Trust funds	93,473	6,736	3,608	4,960	60,047	33,426
Interfund transactions	−6,806	−1	−2,148	5	−6,806	—
Total—Military Functions	115,251,460	7,900,667	7,233,143	11,223,950	100,438,198	14,813,262
Military Assistance						
Federal funds	415,162	69,246	12,878	44,626	411,497	3,665
Trust funds	2,340,201	41,312	30,396	27,573	107,775	2,232,426
Total—Military Assistance	2,755,364	110,558	43,274	72,199	519,272	2,236,091
TOTAL—DEPARTMENT OF DEFENSE	118,006,823	8,011,224	7,276,417	11,296,150	100,957,470	17,049,354

Department of the Army

	Available for obligation	Obligations			Cum thru 30 Jun 1970	Unobligated balance 30 Jun 1970
		Apr 1970	May 1970	Jun 1970		
Military Personnel						
Active forces	8,990,188	831,181	781,979	695,987	8,990,188	—
Reserve forces	763,571	66,629	77,046	106,122	750,629	12,941
Total—Military Personnel	9,753,759	897,810	859,024	862,110	9,740,817	12,941
Operation and Maintenance	8,828,857	759,088	633,979	1,069,506	8,773,142	55,715
Procurement						
Aircraft	813,199	64,159	−25,658	151,718	482,779	330,420
Missiles	990,196	23,031	22,765	48,974	719,520	270,676
Tracked combat vehicles	331,852	13,922	11,103	58,483	267,697	64,155
Ordnance, vehicles and related equipment	4,165,647	253,373	120,052	311,691	3,091,455	1,074,192
Electronics and communications	802,100	22,139	15,124	89,515	298,408	503,692
Other procurement	955,485	23,604	41,148	201,111	653,454	302,031
Undistributed	215,336	180	807	2,573	3,473	211,863
Total—Procurement	8,273,815	400,408	185,341	864,065	5,516,786	2,757,028
Research, Development, Test, and Evaluation						
Military sciences	193,503	10,582	8,267	24,452	173,840	19,663
Aircraft	141,273	3,393	8,777	17,791	82,909	58,364
Missiles	940,094	21,772	27,884	71,053	842,206	97,888
Astronautics	15,442	808	194	6,505	12,384	3,058
Ordnance, vehicles, and related equipment	220,631	14,046	13,065	28,795	163,030	57,601
Other equipment	488,346	21,181	22,208	59,565	344,668	143,678
Program-wide management and support	66,298	3,906	2,948	5,928	55,719	10,579
Undistributed	3,792	−35	−220	792	−215	4,007
Total—Research, Development, Test and Evaluation	2,069,379	75,653	83,123	214,881	1,674,541	394,838
Military Construction	1,488,307	39,234	53,840	181,983	819,808	668,499
Revolving and Management Funds	5,396,766	387,823	384,672	465,097	4,952,108	444,658
Applicable recipts	−70,833	−4,904	−2,919	−3,832	−70,833	—
Subtotal—Federal Funds	35,740,048	2,555,112	2,197,060	3,593,810	31,406,369	4,333,679
Trust Funds	32,840	2,527	2	74	15,286	17,554
Total—Department of the Army	**35,772,888**	**2,557,640**	**2,197,061**	**3,593,884**	**31,421,655**	**4,351,233**

Department of the Navy

Military Personnel						
Active forces	6,531,706	617,224	536,539	550,583	6,528,868	2,838
Reserve forces	191,024	17,859	12,876	26,602	190,871	153
Total—Military Personnel	6,722,730	635,084	549,414	577,185	6,719,739	2,991
Operation and Maintenance	6,598,384	546,733	396,982	859,140	6,593,853	4,533
Procurement						
Aircraft	2,768,132	117,403	134,840	491,512	1,846,546	921,586
Missiles	1,030,561	31,696	18,844	272,082	816,236	214,325
Ships	4,485,249	68,898	71,591	351,984	2,034,402	2,450,847
Tracked combat vehicles	38,592	488	19	3,572	21,142	17,450
Ordnance, vehicles and related equipment	1,339,829	49,318	25,110	78,077	990,664	349,165
Electronics and communications	597,380	29,547	24,818	49,034	380,777	216,603
Other procurement	1,414,705	75,482	53,384	166,711	1,073,396	341,309
Undistributed	72,800	−142	−1,387	645	−3,970	76,770
Total—Procurement	11,747,248	372,690	327,222	1,413,613	7,159,191	4,588,056
Research, Development, Test, and Evaluation						
Military sciences	176,826	7,315	11,813	16,584	142,483	34,343
Aircraft	860,057	39,354	7,589	68,365	761,758	98,299
Missiles	521,282	18,069	8,941	54,587	468,928	52,354
Astronautics	20,501	1,055	132	2,346	19,158	1,343
Ships	360,568	11,015	13,490	18,190	314,202	46,366
Ordnance, vehicles and related equipment	118,880	3,626	226	11,443	105,408	13,472
Other equipment	269,052	10,869	10,678	14,408	240,568	28,484
Program-wide management and support	258,428	14,713	17,651	18,929	206,739	51,689
Undistributed	−15,888	−160	8	−61	−2,370	−13,518
Total—Research, Development, Test, and Evaluation	2,569,706	105,856	70,528	204,791	2,256,874	312,832
Military Construction	1,007,094	44,589	38,731	75,953	554,723	452,371
Revolving and Management Funds	7,966,510	656,583	523,228	527,281	7,285,068	681,442
Applicable Receip s	−38,606	−3,502	−2,216	−3,002	−38,606	—
Subtotal—Federal Funds	36,573,066	2,358,033	1,903,888	3,654,961	30,530,841	6,042,225
Trust Funds	16,654	1,308	940	1,655	13,627	3,026
Interfund Transactions	−6,806	−1	−2,148	5	−6,806	—
TOTAL—DEPARTMENT OF THE NAVY	**36,582,913**	**2,359,339**	**1,902,683**	**3,656,620**	**30,537,662**	**6,045,251**

Department of the Air Force	Available for obligation	Obligations			Cum thru 30 Jun 1970	Unobligated balance 30 Jun 1970
		Apr 1970	May 1970	Jun 1970		
Military Personnel						
Active forces	6,552,406	511,535	654,272	548,124	6,551,879	527
Reserve forces	192,916	17,296	16,722	24,277	192,916	—
Total—Military Personnel	6,745,322	528,830	670,994	572,401	6,744,795	527
Operation and Maintenance	7,298,995	644,343	550,599	595,190	7,286,418	12,577
Procurement						
Aircraft	6,331,514	275,633	504,290	705,401	4,108,333	2,223,181
Missiles	2,076,546	156,871	94,195	206,630	1,620,563	455,983
Ordnance, vehicles and related equipment	1,206,289	33,215	45,942	124,875	1,063,749	142,540
Electronics and communications	786,300	42,574	17,749	121,095	500,912	285,388
Other procurement	491,314	40,917	53,693	10,384	444,409	46,905
Undistributed	128,771	−811	−187	−167	266	128,505
Total—Procurement	11,020,734	548,398	715,684	1,168,219	7,738,234	3,282,500
Research, Development, Test, and Evaluation						
Military sciences	172,592	11,036	10,433	21,787	158,070	14,522
Aircraft	669,936	36,094	19,073	65,532	527,547	142,389
Missiles	1,035,446	57,501	38,303	98,764	976,312	59,134
Astronautics	843,213	47,827	34,576	89,799	749,963	93,250
Other equipment	439,299	28,643	16,881	45,088	319,854	119,445
Program-wide management and support	341,591	23,877	26,353	43,422	330,859	10,732
Undistributed	11,602	−118	−253	−178	−944	12,546
Total—Research, Development, Test, and Evaluation	3,513,679	204,861	145,366	364,214	3,061,660	452,019
Military Construction	462,852	10,250	27,097	28,389	155,426	307,426
Revolving and Management Funds	5,418,088	359,159	385,629	392,710	5,400,240	17,848
Offsetting Receipts	−25,704	−3,384	−1,330	−2,218	−25,704	—
Subtotal—Federal Funds	34,433,966	2,292,457	2,494,039	3,118,904	30,361,068	4,072,897
Trust Funds	43,979	2,900	2,667	3,231	31,134	12,845
TOTAL—DEPARTMENT OF THE AIR FORCE	34,477,945	2,295,356	2,496,707	3,122,135	30,392,202	4,085,743

Defense Agencies/Office of the Secretary of Defense

Operation and Maintenance	1,206,868	107,961	96,341	113,965	1,205,306	1,562
Procurement						
Ordnance, vehicles and related equipment	661	9	3	1	577	84
Electronics and communications	9,115	125	455	1,585	4,679	4,436
Other procurement	124,789	9,184	3,484	17,312	92,414	32,375
Undistributed	2,016	—	—	—	—	2,016
Total—Procurement	136,582	9,318	3,942	18,898	97,670	38,912
Research, Development, Test, and Evaluation						
Military sciences	547,364	44,503	40,402	111,600	482,497	64,867
Undistrributed	—	—	—	—	—	—
Total—Research, Development, Test, and Evaluation	547,364	44,503	40,402	111,600	482,497	64,867
Military Construction	59,828	381	1,871	1,975	6,997	52,831
Revolving and Management Funds	2,784,608	204,566	193,243	255,156	2,749,282	35,326
Offsetting Receipts	−51	−6	−4	−2	−51	—
Subtotal—Federal Funds	4,735,199	366,722	335,794	501,593	4,541,701	193,498
Trust Funds	—	—	—	—	—	—
TOTAL—DEFENSE AGENCIES OSD	4,735,199	366,722	335,794	501,593	4,541,701	193,498

Defense-Wide

Retired Military Personnel						
Retired Pay, Defense	2,858,000	248,568	249,938	251,297	2,853,234	4,766
Operation and Maintenance	43,986	3,534	2,881	7,666	43,398	588
Research, Development, Test, and Evaluation						
Emergency Fund, Defense	—	—	—	—	—	—
Family Housing	690,163	64,856	44,803	82,582	576,877	113,286
Other—Special Foreign Currency Program	15,162	329	330	359	1,760	13,401
TOTAL—DEFENSE-WIDE	3,607,311	317,288	297,951	341,904	3,475,269	132,041

Office of Civil Defense

Civil Defense	75,205	4,323	2,946	7,814	69,708	5,496

Military Assistance

Federal Funds	415,162	69,246	12,878	44,626	411,497	3,665
Trust Funds	2,340,201	41,312	30,396	27,573	107,775	2,232,426
TOTAL—MILITARY ASSISTANCE	2,755,364	110,558	43,274	72,199	519,272	2,236,091

NOTE: All outlay amounts are on a net Treasury basis (gross payments less reimbursement collections), whereas obligations and unpaid obligations are on a gross basis (inclusive of reimbursable activity performed by components of DOD for each other). Therefore, unpaid obligations as of the end of the reporting month cannot be computed from other figures in this report. Details do not add to totals due to rounding.

Prepared by:
Directorate for Program and Financial Control
Office of Assistant Secretary of Defense (Comptroller)
Room 3B877, The Pentagon
Washington, D.C. 20301
Phone: (202) Oxford 7-0021

DEFENSE PROCUREMENT

Pursuant to a decision by the Office of Management and Budget, Executive Office of the President, that as a condition for continuation of the Defense Industry Bulletin, information readily available in other media may not be published here. Defense Procurement will not be published after this issue. Readers may obtain this information from:

Commerce Business Daily
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402.

Remittance for the Commerce Business Daily must accompany the order: $25 annually, plus $30.25 if air mail delivery is requested.

Contracts of $1,000,000 and over awarded during the month of October 1970.

DEFENSE SUPPLY AGENCY

1—****Garland Foods Inc.**, Dallas, Texas, $5,000,000. Approximately 7,000,000 pounds of canned ham (8-14 pound cans). Defense Personnel Support Center, Philadelphia, Pa. DSA 13H-71-D-2038.

13—***DeRossi & Sons, Co.**, Vineland, N.J. $1,561,595. 97,875 men's tropical wool/polyester coats for the Army. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-71-C-0433.

14—**Endicott-Johnson Corp.**, Endicott, N.Y. $1,080,676. 167,160 pairs of men's black oxford shoes. Defense Personnel Support Center, Philadelphia Pa. DSA 100-71-C-0445.

19—***C. M. London Co.**, New York, N.Y. $2,545,715. 2,871,000 linear yards of cotton duck cloth (cotton and rayon filling). Laurens and Spartenburg counties, S.C. Defense Personnel Support Center, Philadelphia, Pa. DSA 100-71-C-0464.

—Island Creek Coal Sales Co., Cleveland, Ohio. $1,400,500. Approximately 112,500 tons of bituminous coal. Holden, Scarlet Glen, and Emmett, W. Va. Defense Fuel Supply Center, Alexandria, Va. DSA-600-71-D-0197.

21—***International Container Service, Inc.** Seattle, Wash. $1,133,072. Warehouse and storage services. DSA-139-71-D-0114.

22—***Kirkpatrick Coal Co.**, Memphis, Tenn. $1,083,275. 138,100 tons of bituminous coal. Caney Creek and Wright, Ken. Defense Fuel Supply Center, Alexandria, Va. DSA 600-71-D-0192.

27—***Logan & Kanawha Coal Co., Inc.**, Cincinnati, Ohio. $1,800,000. 120,000 tons of bituminous coal. Dove, Lark and Home Creek, Va. Defense Fuel Supply Center, Alexandria, Va. DSA-600-71-D-0195.

30—***C. M. London Co.**, New York, N.Y. $1,045,491. 247,000 linear yards of nylon twill cloth. Columbus, Ga. and Westerly, R.I. Defense Personnel Support Center, Philadelphia, Pa. DSA-100-71-C-0515.

—**General Foods Corp.**, White Plains, N.Y. $1,123,575. 1,924,920 units of enriched instant rice (unit = one 150-gram bag and two 325-gram bags). Dover, Del. Defense Personnel Support Center, Philadelphia, Pa. DSA 13H-71-C-5423.

CONTRACT LEGEND

Contract information is listed in the following sequence: Date—*Small Business Firm — Company —Value — Material or Work to be Performed—Location of Work Performed (if other than company plant) — Contracting Agency — Contract Number.

DEPARTMENT OF THE ARMY

1—***Mark Construction, Inc.**, Honolulu, Hawaii. $1,225,000. Construction of a rigid frame laundry with concrete foundation at Schofield Barracks, Hawaii. Army Engineer Division, Pacific Ocean, Fort Armstrong, Hawaii. DA-CA84-71-C-0011.

—**Union Carbide Corp.**, New York, N.Y. $2,501,571. BA-4386/PRC-25 dry batteries, ancillary items, and high-low temperature and internal pressure production testing. Charlotte, N.C. Army Electronics Command, Philadelphia, Pa. DA-AB05-71-C-4431.

—**Stanford Research Institute**, Menlo Park, Calif. $3,437,380 (contract modification). Continued studies in research and development of the Anti-Ballistic Missile defense system. Huntsville, Ala. and Menlo Park. Safeguard Systems Command, Huntsville, Ala. DA-HC60-69-C-0004.

5—The Army Ammuition Procurement and Supply Agency, Joliet, Ill., awarded the following contracts for metal parts for M423 rocket fuzes:

Hamilton Watch Company, Lancaster, Pa. $1,701,000. DA-AA09-71-C-0051.

General Time Corporations, LaSalle, Ill. $1,672,020. DA-AA09-71-C-0052.

Bulova Watch Company, Jackson Heights, N.Y. $1,109,592. DA-AA09-71-C-0050.

Gibbs Manufacturing and Research Corp., Janesville, Wis. $1,465,000. DA-AA09-71-C-0053.

—**Raytheon Co.**, Bedford, Mass. $1,243,437 (contract modification). Supplementary advanced development priority I and II of the Sam D missile systems. Orlando, Fla. and Bedford, Mass. Army Missile Command, Redstone Arsenal, Huntsville, Ala. DA–AH01–67–C&1995.

—***George M. Meyers, Inc.**, El Dorado, Kan. $1,014,357. Paving of approximately three miles of road at Fort Riley, Kan. Army Engineer District, Omaha, Neb. DA–CA45–71–C–0043.

—**Western Electric Co.**, New York, N.Y. $2,033,380 (contract modification). Continued studies on the advanced ballistic missile defense systems. New York, N.Y. and Santa Monica, Calif. Safeguard Systems Command, Huntsville, Ala. DA–HC60–69–C–0008.

—**Westinghouse Electric Corp.**, Mobile, Ala. $1,203,707. Design and manufacture of power transformers in Muncie, Ind., and delivery to Carter's Dam, Coosawatee River, Georgia. Army Engineer District, Mobile, Ala. DA–CW01–71–C–0038.

—**Pace Co.**, Memphis, Tenn. $1,777,500. Loading, assembling and packing of 225,000 cases of 60mm illuminating M83A3 shells, with M65A1 fuzes. East Camden, Ark. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–AA09–71–C–0008.

6—***Coite Somers Co.**, Vidalia, Ga. $3,201,775. Construction of bachelor officer quarters including site work and utilities at Fort Gordon, Ga. Army Engineer District, Savannah, Ga. DA–CA21–71–C–0054.

—**McLean Contracting Co.**, Baltimore, Md. $1,770,410. Removal of existing jetty and construction of a new stone jetty on the inland waterway from Delaware River to Chesapeake Bay. Work also includes 100,000 tons of stone for jetty construction and 700,000 cubic yards of dredging for canal improvement and jetty foundation excavation. Army Engineer District, Philadelphia, Pa. DA–CW61–71–C–0008.

7—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is awarding two contracts for HE M406, 40mm projectile metal parts:

AVCO Corp. Precision Products Division, Richmond, Ind. $2,912,130. DA–AA09–71–C–0025.

Heckethorne Manufacturing Co., Dyersburg, Tenn. $10,140,090. DA–AA09–71–C–0024.

—**Bell Helicopter**, Fort Worth, Tex. $4,942,500. 15 UH–1N helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–70–C–0205.

—**UNECO**, Bellevue, Neb. $1,705,443. Metal parts fo rthe HE1 M56A3 20mm projectile. Frankford Arsenal, Philadelphia, Pa. DA–AA25–71–C–0145.

8—The U.S. Army Ammunition Procurement and Supply Agency, Joliet, Illinois, is awarding the following two contract actions:

***U.S. Components Corp.**, Mt. Clemens, Mich. $1,007,868. Metal parts for the booster, adapter, M148 GP bomb. DA–AA09–71–C–0071.

Harvey Aluminum, Inc., Torrance, Calif. $4,387,382. M118 40mm cartridge cases. DA–AA09–71–C–0030.

—**AVCO Corp.**, Charleston, S.C. $4,676,000. Overhaul and modification of 668 T–53–L13/13A turbine engines applicable to the UH–1H/AH1G aircraft. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–69–A–0308.

—**Bell Helicopter.** Amarillo, Tex. $3,245,428. Repair of 76 UH–1 series crash-damaged aircraft. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–68–D–0056.

9—***Western States Construction Co., Inc.** $1,098,300. Temporary housing services for government personnel at the Grand Forks, N.D., ABM Safeguard site to include furnishing, operating and maintaining a mobile home park complete with 85 three bedroom mobile homes. Army Engineer District, Omaha, Neb. DA–CA45–71–C–0044.

—**Peter Kiewit Sons Co.**, Vancouver, Wash. $6,389,817. Clearing and grading of one-half mile and relocation of Montana State Highway 37 at Libby Dam, Montana. Army Engineer District, Seattle, Washington. DA–CW67–71–C–0027.

—**AVCO Corp.**, Stratford, Conn. $2,331,397. 850 modification kits for T–53 gas turbine engine for the UH–1 aircraft. Army Aviation Systems Command, St. Louis, Mo. DA–AJ01–70–A–0334.

12—**FMC Corp.**, San Jose, Calif. $2,106,000. Inspection and production engineering for the self-propelled, full-tracked M113A1 vehicle. Army San Francisco Procurement Agency, Oakland, Calif. DA–04–200–AMC–02929.

—***Coite Somers Co.**, Vidalia, Ga. $4,670,600. Construction of Southeast Signal School facilities, with supporting utilities and site preparation at Fort Gordon, Ga. Army Engineer District, Savannah, Ga. DA–CA21–71–C–0024.

—**Olin Corp.**, Stamford, Conn. $15,843,431 (contract modification). Operation and maintenance of a government-owned facility at the Badger Army Ammunition Plant, Baraboo, Wis. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–AA09–69–C–0014.

—**Colt's, Inc.**, Hartford, Conn. $20,847,516. 5.56mm M16A1 rifles. Army Weapons Command, Rock Island, Ill. DA–AF–C–0003.

13—***Joseph S. Floyd Corp.**, Norfolk, Va. $1,025,000. Construction of a Sprint/Spartan clean room at the Tar Heel Army Ammunition Plant, Burlington, N.C. Army Engineer District, Savannah, Ga. DA–CA21–71–C–0023.

—**Holloway Construction Co.**, Wixom, Mich. $6,913,799. Construction of a Dam, spillway and appurtenant works, and relocation of railroad and roads at the Clarence J. Brown Dam and Reservoir Project, Clark County, Ohio. Army Engineering District, Louisville, Ky. DA–CW27–71–C–0054.

—The Frankford Arsenal, Philadelphia, Pa. has awarded the following two contract actions:

***Barry L. Miller Engineering, Inc.**, Hawthorne, Calif. $2,450,761. 26,019,300 M14A2 metallic belt cartridge links. DA–AA25–71–C–0158.

Teledyne Mechanical Products Co., El Monte, Calif. $1,278,149. 13,149,680 M14A2 metallic belt cartridge links. DA–AA25–71–C–0159.

14—**Brown Engineering Co.**, Huntsville, Ala. $1,656,931 (contract modification). Ballistic aerial targets. Army Missile Command, Huntsville, Ala. DA–AH01–70–C–0218.

—**General Motors Corp.**, Indianapolis, Ind. $2,918,947. M60 tank transmissions. Army Tank Automotive Command, Warren, Mich. DA–AE07–71–C–0049.

15—**Remington Arms Co.**, Inc., Bridgeport, Conn. $6,171,295. Operation of a government-owned ammunition producing facility at Lake City Army Ammunition Plant, Independence, Mo. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA–49–010–AMC–00003A.

—**American Institutes for Research**, Pittsburg, Pa. $1,063,000 (contract modification). Research and scientific studies for the Army Social Science Research Program, Kensington, Md. Army Research Office, Arlington, Va. DA–HC–19–70–C–0015.

—**Tasker Industries, Bermite Div.**, Saugus, Calif. $1,374,450. Mk 125 Mod 5 igniters for 2.75 inch rocket motors. Indio, Calif. The Picatinny Arsenal, Dover, N.J. DA–AA21–71–C–0186.

16—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is issuing the following four contracts:

Kisco Co., Inc., St. Louis, Mo. $3,158,653. Metal parts for 106mm M94B1 cartridge cases. DA–AA09–71–C–0082. $11,599,665. Metal parts for 105mm M14B4 cartridge cases. Fontana, Calif., Chicago, Ill., Maumee and Willoughby, Ohio, St. Louis, Mo. and Huntsville, Ala. DA–AA09–71–C–0074.

Norris Industries, Los Angeles, Calif. $11,047,300. Metal parts for 105mm M14B4 cartridge cases. Pico Rivera, Calif. DA–AA09–71–C–0073.

***Orweld Steel Products Corp.**, Ellsworth, Mich. $5,909,973. Metal parts for 105mm, TP–T/M489 projectiles. DA–AA09–71–C–0093.

19—**Ralph M. Parsons Co.**, Los Angeles, Calif. $1,234,553 (contract modification). Architect engineer services for the Safeguard engineer services for the Safeguard missile site, radar site and site adaption of this design to Grand Forks, N.D., safeguard site. Army Engineering Division, Huntsville, Ala. DA–CA87–68–C–0001.

—The Safeguard System Command, Huntsville, Ala. is the contracting activity for the following two contracts:

McDonnell Douglas Corp., Huntington Beach, Calif. $10,111,787 (contract modification). Flight test experiment with the purpose of developing missile technology for ABM application. DA–AH–68–C–1237.

Kaman Nuclear Corp., Colorado Springs, Colo. $1,142,183 (contract modification). Lethality and vulnerability analysis for the Safeguard system. DA–HC60–68–C–0020.

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is awarding the following two contracts:

Bulova Watch Co., Inc., Warwick, R.I. $1,620,000. Head assemblies for M525 fuzes. DA–AA09–71–C–0058.

REDM Corp., Wayne, N.J. $4,104,000. Head assemblies for M525 fuzes. DA–AA09–71–C–0057.

20—**Federal Electric Corp.**, Paramus, N.J. $11,191,947. Operations, maintenance, communications engineering and training including operation of two separate area maintenance support facilities in support of the existing integrated communications systems in the Republic of Vietnam. Army Strategic Communications Command, Fort Huachuca, Ariz. DA–EA18–71–C–0024.

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is issuing the following three contract actions:

Airport Manufacturing Corp., Martin, Tenn. $1,673,100. Metal parts for 2.75 inch, XM229 rocket warheads. Union City, Tenn. DA–AA09–71–C–0096.

Honeywell, Inc., Hopkins, Minn. $2,149,655. M219E1 grenade fuzes. Twin Cities Army Ammunition Plant, New Brighton, Minn. DA–AA09–71–C–0086.

Scoville Manufacturing Co., Waterbury, Conn. $1,244,401. M219E1 grenade fuzes. DA–AA09–71–C–0087.

21—**Futuronics Corp.**, Port Washington, N.Y. $5,168,476. AN/GRC–106 radio set; RT–834 receiver-transmitter and ZM–3349 amplifier. Freeport, N.Y. Army Electronics Command, Philadelphia, Pa. DA–AB05–71–C–3703.

—**LTV Electrosystems, Inc.**, Huntington, Ind. $18,037,221. Components of the AN/VRC–12 compact, light weight vehicular radio sets. Army Electronics Command, Philadelphia, Pa. DA–AB05–67–C–0171.

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is awarding the following two contracts:

Chamberlain Manufacturing Corp., Waterloo, Iowa. $1,509,800. Metal parts for warheads for 2.75 inch, M151 rockets. DA–AA09–71–C–0098.

Batesville Manufacturing Co., Batesville, Ark. $1,318,950. Metal parts for M151 warheads for 2.75 inch rockets. DA–AA09–71–C–0099.

—**Mid-County Asphalt Co.**, Euless, Tex. $1,770,249. Construction of two miles of bituminous road relocations at the Lavon Reservoir, Collins County, Tex. Fort Worth Army Engineer District, Fort Worth, Tex. DA–CW63–71–C–0017.

22—**Northrop Corp.**, Anaheim, Calif. $1,556,178. 42,600 WDU–4A/A warheads for the 2.75 rocket. Army Procurement and Suply Agency, Joliet, Ill. DA–AA09–71–C–0022.

23—***Graves Construction Co.**, Blacksburg, Va. $1,499,000. Construction of a one-story earth-covered building to match existing structures at the Radford Army Ammunition Plant, Radford, Va. Army Engineer District, Baltimore, Md. DA–CA31–71–C–0032.

—***Red-Samm Mining Co.**, ***Venture Construction, Inc.**, and ***Shoreline Construction Co.** (joint venture). Bellevue, Wash. $3,177,600. Construction of a water supply system to the Malmstrom, Montana Safeguard site. Pondera and Toole Counties, Montana, Army Engineer District, Seattle, Wash. DA–CA67–71–C–0008.

26—The Picatinny Arsenal, Dover, N.J., is awarding the following contracts:

Muncie Gear Works, Inc., Muncie, Ind. $2,696,772. Nozzle and fin assemblies for 2.75 inch rocket motors. DA–AA21–71–0167.

FTS Corp. div. of HITCO, Denver, Colo.

$3,468,000. Nozzle and fin assemblies for 2.75 inch rocket motors. DA-AA21-71-C-0168. $1,125,000. Fin blades for 2.75 inch rockets. DA-AA21-71-C-0176.

Hoffman Electronics Corp., El Monte, Calif. $1,668,000. Nozzle and fin assemblies for 2.75 inch rocket motors. DA-AA21-71-C-0169.

Dirilyte Co. of America, Inc., Kokomo, Ind. $1,134,803. Fin blades for 2.75 inch rockets. DA-AA21-71-C-0176.

27—**Textron, Inc., Bell Helicopter Co., Div.**, Fort Worth, Tex. $5,420,000. Crash-worthy fuel cell modification kits for UH-1 helicopters. Hurst, Tex. Army Aviation Systems Command, St. Louis, Mo. DA-AJ01-69-A-0314.

28—**White Engines, Inc.**, Canton, Ohio. $1,032,571. Engine assemblies for M151 trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-C-4862.

—***H. W. Stanfield Construction Corp.**, San Diego, Calif. $1,227,679. Construction of two 180-man Airman's Dormitories at Luke AFB, Phoenix, Ariz. Army Engineer District, Los Angeles, Calif. DA-CA09-71-C-0044.

—**Clarkson Construction Co.**, Kansas City, Mo. $2,802,080. Construction of main dam Phase I embankment at the Clarence Cannon Dam and Reservoir, Rawls County, Mo. Army Engineer District, St. Louis, Mo. DA-CW43-71-C-0063.

—**Chrysler Corp.**, Sterling Heights, Mich. $41,850,700. M60A1 combat tanks, M278 vehicles and M60A1 ALVB chassis. Warren, Mich. Army Weapons Command, Warren, Mich. DA-AF03-71-C-0015.

30—**Guy F. Atkinson Co.**, San Francisco, Calif. $36,294,652. Stage III dam construction consisting of spillway, a section of the dam, and the power facilities substructure for the Harry S. Truman Dam and the Reservoir, Osage River, Benton County, Mo. Army Engineer District, Kansas City, Mo. DA-CW41-71-C-0043.

—**Penner Construction Co.**, Lakewood, Colo. $1,697,890. Construction of a 38,000 square foot confinement facility at Fort Carson, Colo. Army Engineer District, Omaha, Neb. DA-CA45-71-C-0056.

—The Army Engineer District, Fort Worth, Tex. is awarding the following contracts:

***Benco, Inc.**, Texarkana, Tex. $1,071,703. To provide large air compressors and related equipment housed in 11 steel frame buildings at the Lone Star Army Ammunition Plant at Texarkana. DA-CA63-71-C-0072.

***Lyda, Inc.**, San Antonio, Tex. $1,194,750. Construction of a masonry cadet dining hall (including food service equipment, heating and air conditioning, utilities, paved sidewalks and drainage facilities) at Lackland AFB, Tex. DA-CA63-71-C-0069.

***Jordan and Nobles Construction Co.**, El Paso, Tex. $1,025,304. Construction of a maintenance dock for small aircraft. Holloman AFB, N.M. DA-CA63-71-C-0071.

—**Textron, Inc., Bell Helicopter Co. Div.**, Fort Worth, Tex. $1,038,662. Hub assemblies for UH-1 helicopters. Army Aviation System Command, St. Louis, Mo. DA-AJ01-69-A-0314.

—**Hercules Engines Div. of White Engines, Inc.**, Canton, Ohio. $20,999,514. Multi-fuel engines for 2½-ton trucks. Army Tank Automotive Command, Warren, Mich. DA-AE07-70-C-1220.

—The Army Ammunition Procurement and Supply Agency, Joliet, Ill. is awarding the following contracts:

Thiokol Corp., Bristol, Pa. $6,107,909 (Contract modification). Operation of a government-owned ammunition facility at the Longhorn Army Ammunition Plant, Marshall, Tex. DA-11-173-AMC-00200(A).

Harvey Aluminum Sales, Inc., Torrance, Calif. $7,769,501. Operation of a government-owned ammunition facility at Milan, Tenn. Army Ammunition Plant. DA-11-173-AMC-00520(A).

Olin Corp., Stanford, Conn. $31,580,324. Operation of a government-owned facility for production of propellants at Army Ammunition Plant, Charleston, Ind. DA-AA09-69-C-0148.

U.S. Steel Corp., Pittsburgh, Pa. $3,602,203 (contract modification). Metal parts for 8-inch M106 projectiles. Berwick, Pa. DA-AA09-70-C-0238.

Chamberlain Manufacturing Corp., New Bedford, Mass. $4,188,600 (contract modification). Metal parts for 155m, M107 projectiles. DA-AA09-71-C-0075. Elmhurst, Ill. $5,056,462. Metal parts for 155m, M107 projectiles. Scranton, Pa. DA-AA09-71-C-0079.

Donovan Construction Co., New Brighton, Minn. $7,135,927. Metal parts for 155m, M107 projectiles. DA-AA09-71-C-0077.

Batesville Manufacturing Co., Batesville, Ark. $1,318,950. Metal parts for high explosive M151 warheads. DA-AA09-71-C-0099.

***Keystone Baystate Industries**, Boston, Mass. $1,645,206. Metal parts for M1 delay plungers for M557 fuzes. DA-AA09-71-C-0106.

Hayes Albion Corp., Albion, Mich. $1,600,200. Metal parts for M229 warheads. Hillsdale and Albion, Mich. DA-AA09-71-C-0117.

Norris Industries, Vernon, Calif. $2,979,410. 105mm, M393A2 projectiles. DA-AA09-71-C-0119.

National Presto Industries, Inc., Eau Claire, Wisc. $2,546,104 (contract modification). Metal parts for 8-inch, M106 projectiles. DA-AA09-69-C-0109.

Western Electric Co., New York, N.Y. $3,199,507 (contract modification). Engineering services for Nike Hercules weapons system. Burlington, N.C., Titusville, Fla. and Syracuse, N.Y. DA-AH01-68-C-0405.

—**Jeep Corp.**, Wayne, Mich. $72,628,497. Two ½ ton trucks, M44 series. South Bend, Ind., Rulo, Neb. Army Tank Automotive Command, Warren, Mich. DA-AE06-70-C-0001.

—**Raytheon Co.**, Andover, Mass. $11,614,698. Engineering services for Improved Hawk weapons system. Andover and Bedford, Mass. and White Sands Missile Range, N.M. Army Missile Command, Huntsville, Ala. DA-AH01-71-C-0252.

—**Ravenna Arsenal, Inc.**, Ravenna, Ohio. $1,752,707 (contract modification). Operation of a government-owned facility for ammunition. Army Ammunition Procurement and Supply Agency, Joliet, Ill. DA-AA09-70-C-0002.

DEPARTMENT OF THE NAVY

1—**Magnavox Co.**, Fort Wayne, Ind. $1,179,808. AN/SSQ-41A sonobuoys. Naval Air Systems Command, Washington, D.C. N00019-70-C-0411.

—**R. D. Lambert and Son, Inc.**, Chesapeake, Va. $2,289,267. Construction of an aircraft overhaul and repair shop at the Naval Air Rework Facility, Norfolk, Va. Naval Facilities Engineering Command, Washington, D.C. N62470-70-C-0881.

—**Grumman Aerospace Corp.**, Bethpage, N.Y. $8,700,000. Long lead-time items in support of FY 1970 procurement of A-6E aircraft. Naval Air Systems Command, Washington, D.C. N0030-69-C-0075.

—**Massachusetts Institute of Technology**, Cambridge, Mass. $3,500,000. Design of an optimum guidance system for the ULMS (Underwater Long Range Missile System). Naval Strategic Systems Project Office, Washington, D.C. N00030-71-C-0097.

2—**DeLaval Turbine Corp.**, Trenton, N.J. $13,996,000. Fuel oil pumps, associated equipment and data for the Navy standard distillate fuel program. Naval Ship Systems Command, Washington, D.C. N00024-70-C-5497.

—**EDO Corp.**, College Point, N.Y. $2,694,454 (contract modification). Conversition kits and related production assemblies for the Mk 82 Mod 0 underwater mine. Naval Ordnance Systems Command, Washington, D.C. N00017-70-C-1419.

—**LTV Aerospace Corp.**, Dallas, Tex. $1,264,000. Building maintenance at the Naval Weapons Reserve Plant at Dallas. Naval Air Systems Command, Washington, D.C. N00019-70-C-9024.

5—Naval Air Systems Command, Washington, D.C. is awarding the following contract actions:

Grumman Aerospace Corp., Bethpage, L.I., N.Y. $207,968,117. FY 71 procurement of F-14A aircraft. N00019-69-C-0422.

Hughes Aircraft Co., Culver City, Calif. $10,000,000. Phoenix missiles. Culver City, El Segundo, Torrance, and Fullerton, Calif. and Tucscon, Ariz. N00019-67-C-0204. $137,556,296. FY 1971 procurement of AN/AWG-9 and AN/AWN-23 airborne missile control systems. Canoga Park, Culver City, El Segundo, Calif. and Tucscon, Ariz. N00019-70-C-0207.

—**Woods Hole Oceanographic Institution**, Woods Hole, Mass. $1,575,000. Research in physical oceanography, marine geodesy, chemical oceanography, marine geology and geophysics. Office of Naval Research, Washington, D.C. N00014-66-C-0241.

—**Far West Construction Co.** and **C. W. Jessen Construction Co.** (joint venture), Fresno, Calif. $2,826,800. Construction of an enlisted men's barracks at the Naval Air Station, Lemore, Calif. Western Division, Naval Facilities Engineering Command, San Bruno, Calif. N62474-70-C-0614.

—**Sperry Rand Corp.**, St. Paul, Minn. $3,285,906. Computer programs and/or parts of computer programs or Staff Data Systems for Sleet Computer Programming Center, Pacific and Contractors Facility, San Diego, Calif. Naval Regional Procurement Office, Los Angeles, Calif. N00123-71-C-0163.

6—**Dillingham Corporation of the Pacific**, Honolulu, Hawaii. $1,158,000. Construction of shoreline protection at Johnston Atoll. Naval Facilities Engineering Command, Pacific Division, San Francisco, Calif. N62471-70-C-0284.

—**Applied Physics Laboratory, Johns Hopkins University**, Silver Spring, Md. $21,422,525. Increase in research and development studies. Naval Ordnance Systems Command, Washington, D.C. N00017-62-C-0604.

7—**Newport News Shipbuilding and Dry Dock Co.**, Newport News, Va. $24,583,451. Preparation and accomplishment of the overhaul, refueling, and C-3 Poseidon conversion of the USS Nathanael Greene. Naval Ship Systems Command, Washington, D.C. N00024-69-C-0231.

—**Computer Sciences Corp.**, Falls Church, Va. $6,540,942. Acoustic Intelligence Data Systems at Silver Spring, Md. Naval Purchasing Office, Washington, D.C. N00600-69-C-1166.

—**International Telephone and Telegraph Corp.**, Nutley, N.J. $6,332,235. AN/WSC-2(XN-1)(V) shipboard satellite communications sets with antennas, services

and data. Naval Electronics Systems Command, Washington, D.C. N00039–71–C–0011.

—**McDonnell-Douglas Corp.**, St. Louis, Mo. $5,515,000. Long lead items in support of F–4E and RF–4C aircraft for the Air Force. Naval Air Systems Command, Washington, D.C. N00019–69–C–0521.

—**Singer-General Precision, Inc.**, Silver Spring, Md. $2,000,000. Device 2F87(T), T–3C tactics trainer, technical data information services and support. Naval Training Device Center, Orlando, Fla. N61339–70–C–0038.

—**R. C. Hedreen Co.**, Seattle, Wash. $2,584,000. Construction of a woodworking shop at the Naval Shipyard, Bremerton, Wash. Naval Facilities Engineering Command, Western Division, San Bruno, Calif. N62474–70–C–0886.

8—**Continental Electronics Manufacturing Co.**, Dallas, Tex. $3,536,438. Omega antenna tuning sets, repair parts, services, support and data. Naval Electronic Systems Command, Washington, D.C. N00039–71–C–0012.

—**Goodyear Aerospace Corp.**, Akron, Ohio. $15,555,775. Production of Subroc guided Mk 28, Mod 1 missile. Naval Ordnance Systems Command, Washington, D.C. N00017–71–C–1401.

—**Lockheed Aircraft Corp.**, Burbank, Calif. $57,000,004 (contract modification). Incremental funding for the development of the S–3A aircraft and exercising an option for two additional test aircraft. Naval Air Systems Command, Washington, D.C. N00019–69–C–0385.

9—**Gould, Inc.**, Trenton, N.J. $1,028,386. Lead acid storage batteries. Trenton, Monroe, Mich. and Kankakee, Ill. Naval Purchasing Office, Washington, D.C. N00600–71–C–0353.

—**Westinghouse Electric Corp.**, Baltimore Md. $8,000,000 (contract modification). Increase the scope of work and increase the limitation of authorization for pilot production of Mk 48, Mod 1 torpedoes with supporting equipment. Lansdowne, Md. and Friendship Airport facilities, Md. Naval Ordnance Systems Command, Washington, D.C. N00017–70–C–1211.

—**Clevite Ordnance Division, Gould, Inc.** $10,000,000. Pilot production of Mk 48, Mod 1 torpedoes with supporting equipment. Naval Ordnance Systems Command, Washington, D.C. N00017–71–C–1302.

12—**Martin Marietta Corp.**, Baltimore, Md. $1,523,764. Prototyping of DIFAR (Directional Finding and Ranging) and related equipment on S–2E aircraft. Naval Air Systems Command, Washington, D.C. N00019–71–C–0076.

—**R. C. Hedreen Co.**, Seattle, Wash. $1,324,342. Construction of a bachelor officers quarters, with mess, at Naval Air Station, Whidbey Island, Wash. Commander, Western Division, Naval Facilities Engineering Command, San Bruno, Calif. N62474–71–C–4023.

13—**Westinghouse Electric Corp.**, Wilkins Township, Pa. $25,570,000. Nuclear reactor compartment components. Naval Ship Systems Command, Washington, D.C. N00024–71–C–5076.

—**Littons Systems Inc.**, Pascagoula, Miss. $2,677,647. Advance preparation for the overhaul of the nuclear powered attack submarine, USS Gato (SSN 615). Naval Ship Systems Command, Washington, D.C. N00024–71–C–0223.

14—**Susquehanna Corp.**, Alexandria, Va. $2,317,554 (contract modification). Mk 30 Mod 2 rocket motors for Standard missiles. Naval Ordnance Systems Command, Washington, D.C. N00017–68–C–2103.

—**General Dynamics Corp.**, Groton, Conn. $77,900,000. Construction of the nuclear-powered, electric drive submarine (SSN 685). Naval Ship Systems Command, Washington, D.C. N00024–70–C–0307.

16—**Univac Div. of Sperry Rand Corp.**, St. Paul, Minn. $9,962,000. 41 AN/UYK–7 computers. Naval Ship Systems Command, Washington, D.C. N00024–71–C–1039.

—**Sperry Gyroscope Co. Div. of Sperry Rand Corp.**, Great Neck, N.Y. $1,675,000 (contract modification). Mk 76 Mods 3 and 5 fire control systems for Terrier missiles. Naval Ordnance Systems Command, Washington, D.C. N00017–70–C–2308.

—**General Dynamics Corp.**, Electric Boat Div., Groton, Conn. $11,677,900. Overhaul of the nuclear powered submarine USS Sturgeon (SSN–637). Naval Ship Systems Command, Washington, D.C. N00024–70–C–0227.

19—**Sperry Rand Corp.**, Syosset, N.Y. $17,405,000. Poseidon (C–3) Inertial navigation subsystem equipments for five ships and two sets of training equipment. Naval Ship Systems Command, Washington, D.C. N00024–71–C–5112.

—**General Electric Co.**, Burlington, Vt. $1,869,758. Design, develop, test and deliver 21 20mm light weight gun pods to be used on OV–10, A–4, A–7, F–4B aircraft and various helicopters. Naval Regional Procurement Office, Los Angeles, Calif. N00123–71–C–0194.

20—**FMC Corp.**, Minneapolis, Minn. $7,865,000. Engineering development of the Mark 26 Mod 0, 1 and 2 guided missile launching system. Fridley, Minn. Naval Ordnance Systems Command, Washington, D.C. N00017–68–C–2109.

—**Honeywell, Inc.**, West Covina, Calif. $1,738,520. AN/SQS–26CX modular addition to sonar training equipment devices, 14A2B and 14A2F. Naval Training Device Center, Orlando, Fla. N61339–70–C–0078.

—**General Dynamics Corp.**, Groton, Conn. $1,014,000. Planning yard services for the NR–1 nuclear-powered ocean engineering and research submarine. Naval Ship Systems Command, Washington, D.C. N00024–71–C–0222.

—**Swiftships, Inc.**, Morgan City, La. $1,184,982. Construction of six 65-foot aluminum Mark I patrol boats. Naval Ship Systems Command, Washington, D.C. N00024–71–C–0211.

—**United Aircraft Corp.**, Stratford, Conn. $1,000,000. Long lead-time items for the CH–53C helicopter program for the Air Force. Naval Air Systems Command, Washington, D.C. N00019–69–C–0621.

21—**Stromberg-Datagraphix, Inc.**, San Diego, Calif. $1,900,000. AN/ASA–70 tactical display groups. Naval Air Systems Command, Washington, D.C. N00019–71–C–0151.

22—**F&M Systems Co.**, Dallas, Tex. $2,999,443. Special electronic systems including UHF/VHF antennas. Naval Ship Systems Command, Washington, D.C. N00024–71–C–1088.

23—**ITT Gilfillan, Inc.**, Van Nuys, Calif. $1,592,550. Manufacture of AN/SPN–43(A) radar pedestals. Naval Electronic Systems Command, Washington, D.C. N00039–71–C–0105.

—**Raytheon Co.** North Dighton, Mass. $1,927,524. Seven Navy nuclear submarine (SSN) signal data convertors, which includes all technical data, installation kits, repair parts, related engineering services and support training. Naval Ship Systems Command, Washington, D.C. N00024–71–C–1083.

26—**Aluminum Company of America**, Pittsburg, Pa. $1,832,269. Chemical aluminum powder used in Mark 81/82/83/84 bombs. Rockdale, Tex. Naval Ships Parts Control Center, Mechanicsburg, Pa. N00104–71–C–A021.

—The Naval Air Systems Command is awarding the following contracts:

Raytheon Co., Lexington, Mass. $5,544,026. Guidance and control groups for Sidewinder IC for the Navy and Air Force. Lowell, Mass. N00019–70–C–0299.

Williams Reasearch Corp., Walled Lake, Mich. $1,586,150. YJ400–WR–400 air turbine jet engines. N00019–71–C–0075.

Royal Industries, Santa Ana, Calif. $1,235,823. 600-gallon capacity, external fuel tanks for the Air Force. N00019–71–C–0074.

27—**Baugh and Coody, Inc.**, Albany, Ga. $2,347,000. Construction of a 4600-man mess hall, Second Male Recruit Camp at Naval Training Center, Orlando, Fla. Commander, Southern Division, Naval Facilities Engineering Command, Charleston, S.C. N62467–68–C–0345.

—**Energy Systems, Inc.**, Palo Alto, Calif. $3,140,530. AN/TRC–97A tropospheric communications system with peripheral equipment and associated data. Naval Electronics Systems Command, Washington, D.C. N00039–71–C–0314.

—**United Aircraft Corp.**, Stratford, Conn. $1,226,928. Progressive aircraft rework and related services on VH–3A helicopters. Stratford and Bridgeport, Conn. Naval Air Systems Command, Washington, D.C. N00019–71–C–0109.

28—The Naval Ship Systems Command is issuing the following two contracts:

General Dynamics Corp., Electric Boat Div., Groton, Conn. $3,727,096. Preparation work on the overhaul of nuclear submarines USS Nautilus (S–SN–571) and USS Tullibee (SSN–597). N00024–71–C–0238.

Newport News Shipbuilding and Dry Dock Co., Newport News, Va. $2,589,945. Advance planning and design of the Poseidon (C–3) conversion and overhaul of the USS Henry Stimson (SSBN 655). N00024–71–C–0209.

—**McDonnell Douglas Corp.**, Tulsa, Okla. $1,273,966. Operation, maintenance, and configuration of two electronic countermeasure (ECM) aircraft and equipment including test flights for a period of 12 months. Naval Ordnance Systems Com-Command, Washington, D.C. N00024–71–C–4403.

DEPARTMENT OF THE AIR FORCE

1—Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, is issuing the following two contract modifications:

Texas Instruments, Inc., Dallas, Tex. $1,803,124. Airborne radar equipment (AN/APQ–99). F33657–70–C–0631.

Bourns/CAI, Inc., Barrington, Ill. $4,390,833. Procurement and installation of aerial cameras in RF–4 aircraft. F3657–69–C–1282.

—*MacLeod Co., Cincinnatti, Ohio. $1,624,117. 2600-gallon capacity, water tank trucks. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F0963–71–C–0318.

2—**Automatic Electric Co.**, Northlake, Ill. $1,175,000. Equipment and services applicable to the Overseas Autovon System. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. AF19(628)–596.

5—**Cleveland Pneumatic Co.**, Cleveland, Ohio. $1,633,715. Production of structural components applicable to the main landing gear of C–141 aircraft. Ogden Air Materiel Area, AFLC, Hill AFB, Utah. F42600–71–C–1231.

—Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, is awarding the following contract actions:

Boeing Co., Seattle, Wash. $1,600,000. Research and development of a Short Range Attack Missile (SRAM). AF33(657)–16584.

Texas Instruments, Inc., Dalls, Tex.

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$1,644,000. Procurement of spare parts for AC–130A aircraft. F33657–71–C–0148.

—**Martin Marietta Corp.**, Denver, Colo. $4,604,686 (contract modification). Design, develop and fabricate Titan III–C space boosters and associated aerospace ground equipment. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04695–67–C–0142.

—**Hayes International Corp.**, Birmingham, Ala. $2,721,150. Inspection and repair as necessary, maintenance and modification of C–130 aircraft. Warner-Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603–70–C–0793.

6—**General Electric Co.**, Philadelphia, Pa. $15,268,500 (contract modification). Production of the Mark–12 re-entry system. Space and Missiles Systems Organization, Los Angeles, Calif. F04701–68–C–0178.

—**General Dynamics Corp.**, Fort Worth, Tex. $5,000,000 (contract modification). F–111 aerospace ground equipment. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. AF33(657)–13403.

—**Honeywell, Inc.**, Tampa, Fla. $1,605,000 (contract modification). Production of multiplexer sets and associated spare parts. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F34601–70–C–1405.

—**Lockheed Aircraft Corporation**, Marietta, Ga. $3,602,657. Procurement of spare parts for C–5A aircraft. Detachment 31, San Antonio Air Materiel Area, AFLC, Marietta, Ga. AF33(657)–15053.

—**Sperry Rand Corporation**, Washington, D.C. $2,985,000. Electronic data processing equipment. Rosville, Minn. 2750th Air Base Wing, Wright-Patterson AFB, Ohio. F33600–71–F–0851.

8—**TRW, Inc.**, Redondo Beach, Calif. $1,688,628. Services and data for the integration and checkout of a tactical air control system. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628–70–C–0313.

—Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio, is awarding the following contract actions:

General Electric Company, Cincinnati, Ohio. $1,998,000 (contract modification). Development of an advanced turbine engine gas generator. Evendale, Ohio. F33657–70–C–0340.

Westinghouse Electric Corp., Baltimore, Md. $2,000,000. Modification of B–57G aircraft. F33657–68–C–1050.

General Electric Co., Utica, N.Y. $1,100,000. Procurement of canisters used in electronic counermeasure pods for tactical aircraft. F33657–71–C–0147.

LTV Electrosystems, Greenville, Tex. $4,906,683. Modification of OV–10 aircraft. F33657–71–C–0358.

9—Ogden Air Materiel Area, AFLC, Hill AFB, Utah, is awarding the two following contract actions:

Sargent-Fletcher Company, El Monte, Calif. $9,756,948. Production of 750 pound bombs. F42600–71–C–1177.

Menasco Manufacturing Co., Fort Worth, Tex. $2,055,935. Production of component parts of the main landing gear for B–52 aircraft. F42600–71–C–1234.

12—**Chromalloy American Corp.**, San Antonio, Tex. $1,038,554. Repair and protective coating services for J–57 aircraft engine compressor blades. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F41608–70–D–1105.

—**Mitre Corp.**, Bedford, Mass. $16,958,000. Research and development in the field of advanced information and communication systems. Electronic Systems Division, AFSC, L. G. Hanscom Field, Mass. F19628–71–C–0002.

13—**Hughes Aircraft**, Culver City, Calif. $2,963,675. Modification kits and spare parts for the improvement of weapon control systems on F–106 and F–101 aircraft. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603–71–C–3427.

—**Boeing Co.**, Seattle, Wash. $2,023,000. Design, development, study and test programs for Minuteman space missiles. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–69–C–0153.

14—**Cessna Aircraft Co.**, Wichita, Kan. $2,748,001. A–37B aircraft testing program. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–71–C–0163.

—**Chromalloy American Corp.**, San Antonio, Tex. $1,331,811. Repair services for vane and shroud assemblies for J–57 jet aircraft engines. Oklahoma City Air Materiel Area, AFLC, Tinker AFB, Okla. F146008–70–D–0212.

—***QED Modular Buildings, Inc.**, Richmond, Calif. $1,178,683. 14 modular, relocatable dependent school buildings. Civil Engineering Center, AFSC, Wright-Patterson AFB, Ohio. F33615–71–C–1081.

—**FWD Corp.**, Clintonville, Wisc. $1,189,282. Eight fire fighting trucks. Warner Robins Air Materiel Area, AFLC, Robins AFB, Ga. F09603–71–C–0343.

16—**R. G. LeTourneau, Inc.**, Longview, Tex. $1,203,344. Procurement of material handling equipment. San Antonio Air Materiel Area, AFLC, Kelly AFB, Tex. F41608–69–D–6504.

19—**Kollsman Instrument Corp.**, Elmhurst, N.Y. $7,518,000. AAU–19/A altimeter instruments for aircraft. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–71–C–0109.

—**Thiokol Chemical Corp.**, Bristol, Pa. $5,158,181. Production of stage I motors for Minuteman III missiles, Brigham City, Utah, Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–69–C–0197.

20—**Rand Corp.**, Santa Monica, Calif. $5,000,000. Aerospace studies and research. Office of Scientific Research, AFSC, Arlington, Va. F44620–67–C–0045.

21—**General Motors Corp., Delco Electronics Div.**, Milwaukee, Wisc. $8,470,344. Design, development, fabrication and delivery of Titan IIIC inertial guidance system. Space and Missiles Systems Organization, Los Angeles, Calif. F04701–71–C–0128.

—**Bendix Corp., Electrodynamics Div.**, North Hollywood, Calif. $6,825,000. Modification of airborne radar equipment. Slymar, Calif. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–70–0730.

22—**Northrop Corp.**, Norwood, Mass. $2,653,895. Production of electronic components applicable to the guidance and control system for Minuteman III. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–70–C–0160.

—**Thiokol Chemical Corp.**, Brigham City, Utah. $3,800,000. Production of illumination flares. Armament Development and Test Center, ALFC, Elgin AFB, Fla. F08635–71–C–0049.

23—The Ogden Air Materiel Area, AFLC, Hill AFB, Utah, is awarding the two following contracts for production of dispensers for air munitions:

Monnfield Industries, Inc., Garland, Tex. $4,080,095. F42600–71–C–1264.

Lanson Industries, Cullman, Ala. $4,074,409. F42600–71–C–1229.

—**Boeing Co.**, Wichita, Kan. $1,147,474. Modification of B–52 aircraft. Oklahoma City Air Materiel Area, Tinker AFB, Okla. F34601–69–C–3987.

26—**Boeing Co.**, Seattle, Wash. $27,100,000. Long lead effort and data in support of the FY 1971 production of the short range attack missile (SRAM). Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–70–C–0876.

27—**Boeing Co.**, Seattle, Wash. $1,835,497. Electronic components applicable to Minuteman III weapons system. Ogden Air Materiel Area, Hill AFB, Utah. F04606–70–A–0084.

—**Lockheed Aircraft Corp.**, Marietta, Ga. $9,030,629. Production and modification of C–141 aircraft. Aeronautical Systems Division, Wright-Patterson AFB, Ohio. AF33657–8835.

—**Sylvania Electric Products, Inc.**, Needham, Mass. $5,485,774. Operate, maintain and perform minor modification to the missile tracking radar system at Kwajalein Atoll. Electronic Systems Command, AFSC, L. G. Hanscom Field, Mass. F19628–70–C–073.

28—**General Dynamics Corp.**, Fort Worth, Tex. $35,798,108 (contract modification). Research and development of F–111A and FB–111A aircraft. Aeronautical Systems Division, Wright-Patterson AFB, Ohio. AF33(657)–8260.

30—**American Standard, Inc.**, Kansas City, Mo. $1,132,840. VHF communication system for UH–1H helicopters. Aeronautical Systems Division, AFSC, Wright-Patterson AFB, Ohio. F33657–71–C–0259.

—**Boeing Co.**, Seattle, Wash. $1,594,963 (contract modification). Procurement of long lead time of spare parts for short range attack missiles (SRAM). Oklahoma Air Materiel Area, Tinker AFB, Okla. F33657–70–C–0876. $1,913,040. Spare parts and force modernization ground equipment for Minuteman III missiles, Ogden, Utah and Seattle, Wash. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–70–C–0136.

—**Honeywell, Inc.**, St. Petersburg, Fla. $11,575,000. Guidance and control systems for Minuteman III missiles. Space and Missile Systems Organization, AFSC, Los Angeles, Calif. F04701–69–C–0176. $3,809,614. Production of components for Minuteman III guidance and control system. Space and Missile Systems Organization, Los Angeles, Calif. F04701–69–C–0176.

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Lasers Map V/STOL Airflow in AEDC Research

Laser technology, developed and used at the Air Force Systems Command's Arnold Engineering Development Center (AEDC), Arnold AFS, Tenn., is playing a key role in a research program designed to improve V/STOL aircraft. Object of the program, sponsored by the Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio, was to construct a 3-dimensional mathematical model of the flow field created when the downwash of a helicopter or V/STOL aircraft strikes the ground in crosswinds of varying intensities.

Principal tool being used by researchers of ARO., Inc., contract operator of the center, is a laser velocimeter developed by the firm's technical staff that simultaneously measures the vertical, horizontal and lateral components of the flow field. In tests so far, only vertical and horizontal component measurements were made. Test conditions created might be compared with a helicopter or V/STOL aircraft in hover with a 5- to 17-miles-per-hour crosswind. Precise velocity measurements at these low speeds are very difficult, and velocity directions change radically in a very short distance.

The laser velocimeter is the only practical way to obtain the needed information since the beams create no disturbance of their own in the flow field. Any attempt to use a mechanical probe would disturb the airflow to such an extent that no valid measurements could be made.

The test series was conducted in a tunnel constructed at the center several years ago specifically for investigation in the V/STOL area. The test section of the tunnel is 30-by-45 inches in cross section and 6 feet long. A flat plate was installed to represent the ground and a vertical air duct to simulate downwash of the aircraft. A smoke generator provided scattering particles for the laser.

The velocimeter uses a 0.015-watt helium-neon laser with a self-aligning optics package that splits the beam into a reference beam and three scatter beams—one for measuring the vertical flow component, one for the horizontal component, and one for the lateral component. A collimating lens focuses the beams at a common point where velocity measurements are made. This focal point can be shifted throughout the flow field, thus providing a velocity map of the field.

The advent of a usable laser velocimeter, as shown in this program, will greatly assist the aerospace engineer in the solution of many of the complex flow field problems associated with obtaining design data for future V/STOL aircraft.

Speed and direction of the flow within the turbulent area are computed by the computerized mathematical model. Crosswind effects are also taken into account. In the immediate future, this type of information could find application in preparation of operating procedures for helicopters. Later, it could aid in the development of V/STOL aircraft by predicting the flow field various aircraft designs would generate.

This research program is under the direction of E. H. Flinn, Chief, V/STOL Stability and Control Group, Air Force Flight Dynamics Laboratory. The laser velocimeter was developed under the direction of A. E. Lennert of ARO, Inc.

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